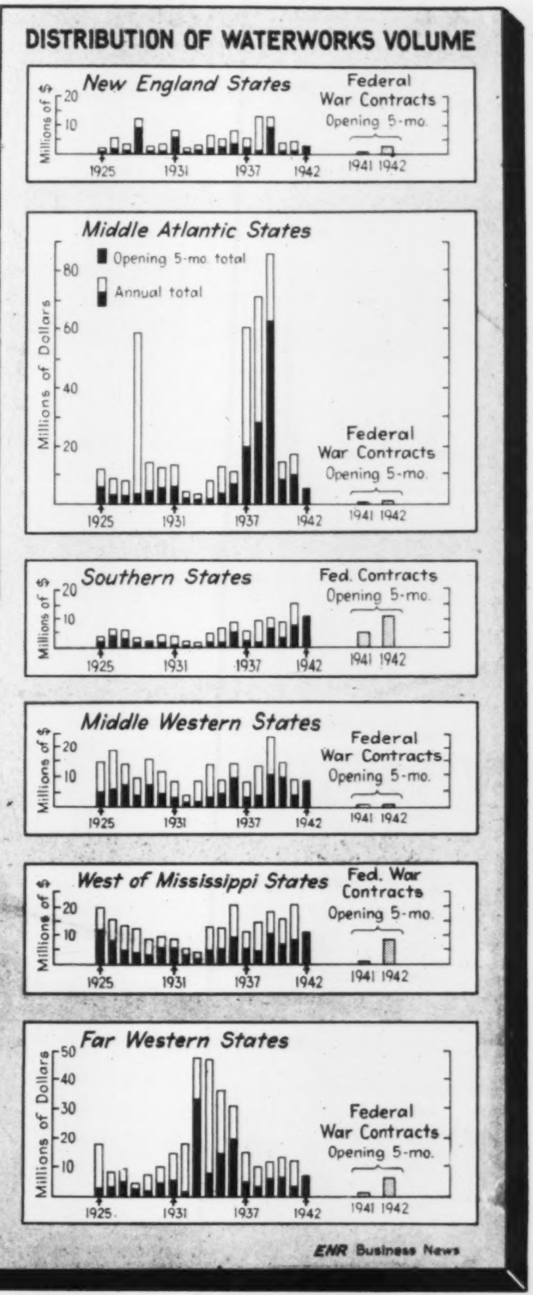
CONSTRUCTION TRENDS

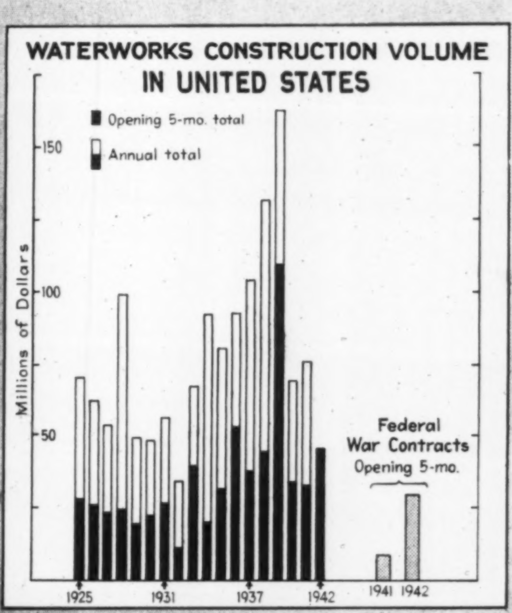
Notes on significant movements in the construction industry

Federal projects boost waterworks volume

THE GREATLY INCREASED VOLUME of federal work brings the 1942 five-month waterworks total to $45,462,000, the third highest peak on record. The PWA-primed volumes of the opening five months of 1936 and 1939 are the only totals to surpass the current year's waterworks construction figure.

Construction of federally-financed waterworks facilities during the first five months of the year reached $30,326,000, approximately two-thirds of the volume reported by *Engineering News-Record* for this type of work. The federal total, which includes water supply facilities in strategic industrial areas, army camps, naval bases, airbases, etc., is almost 3½ times the government-financed total for the corresponding period last year, and it already exceeds the $22,408,000 in federally-owned waterworks projects reported for the entire year 1941.





ENR Business News

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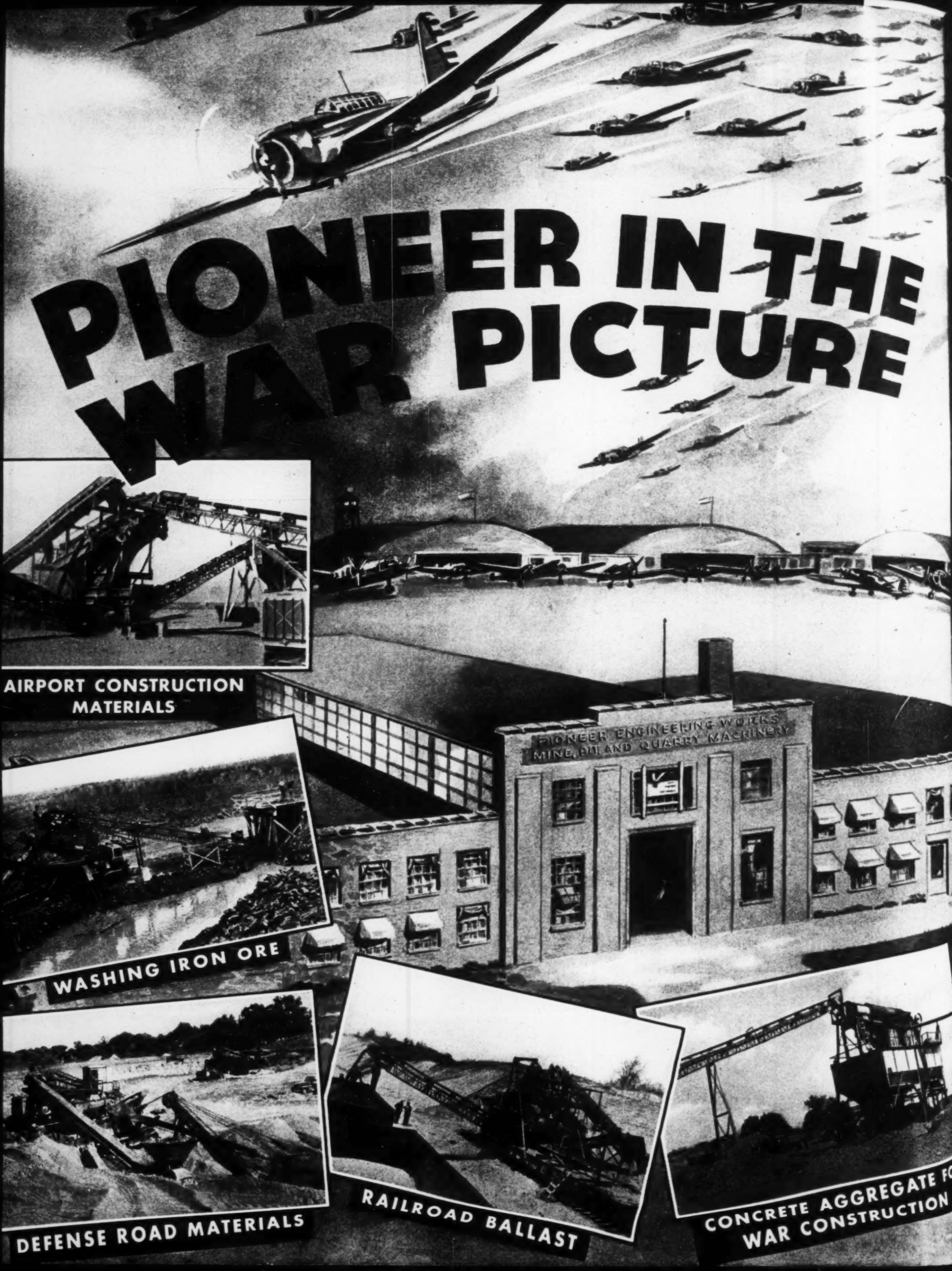
PIONEER IN THE WAR PICTURE
PIONEER ENGINEERING WORKS
MINING, PIT AND QUARRY MACHINERY
AIRPORT CONSTRUCTION MATERIALS
WASHING IRON ORE
DEFENSE ROAD MATERIALS
RAILROAD BALLAST
CONCRETE AGGREGATE FO
WAR CONSTRUCTION

PIONEER ENGINEERING WORKS

MINNEAPOLIS · MINNESOTA

ENGINEERING NEWS-RECORD

Devoted to Buildings, Sewers, Waterworks, Bridges, Highways, Streets, Dams, Foundations, Earthwork, Flood Control, Public Works, Irrigation, Canals, Railroads
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Vol. 128 JUNE 18, 1942 No. 25

COMING NEXT

- How to design plywood girders to be assembled with ring connectors for use under heavy loading in highway bridge construction. These design principles were arrived at as a result of extensive tests recently conducted by the Carnegie Institute of Technology.
- A maintenance story that tells what was done in order to keep over 376 pieces of heavy-duty construction equipment operating "around the clock" on a 6,000,000 cu.yd earthmoving job provides a valuable lesson in advance planning and efficiency.
- How to build a fleet of Liberty ships—a story that tells how these cargo vessels are being assembled on shipways and in special basins, and why prefabrication, sub-assembly and welding methods have been adopted to speed up their construction.

LOOKING AHEAD

- A pincers movement may be a military operation but some of our city engineers are willing to bet it has a counterpart on the home front. One prong is the relentless growth of population, requiring more and more public services, while the other is represented by the restrictions that slow up construction progress. San Diego and El Paso are two war cities caught in such a pincers movement whose situation verges on the desperate. Their problems, ranging through water, sewerage, traffic and housing, will be the subject of two articles planned for early publication.
- Earth dam building has developed into a scientific operation since the Proctor needle and its uses were first presented in this journal by its originator ten years ago. Engineers of the Tennessee Valley Authority, during seven years of experience with earth dam construction, have developed a variation of the Proctor needle known as the penetrometer. How its use, in combination with a few simple tests, eliminates tedious moisture-density and mechanical analysis determinations is described in an article about ready for scheduling.

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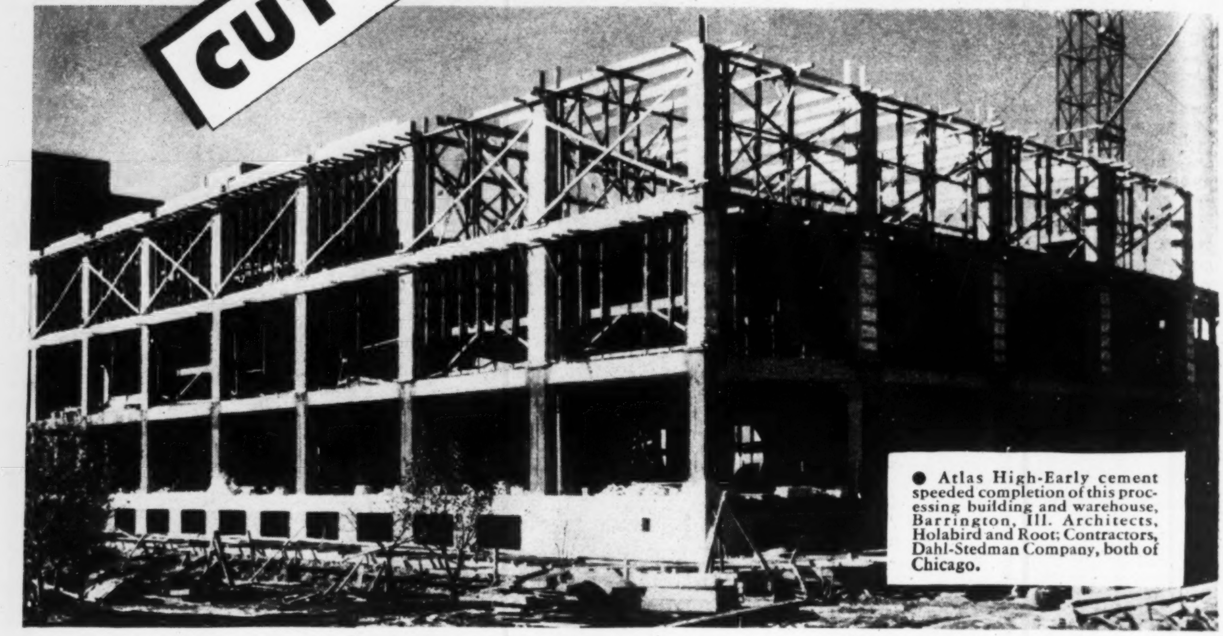
TIME FOR COMPLETION
NUMBER OF FORMS USED
COST OF FORM LUMBER
CUT IN HALF!



● Atlas High-Early cement speeded completion of this processing building and warehouse, Barrington, Ill. Architects, Holabird and Root; Contractors, Dahl-Stedman Company, both of Chicago.

Atlas High-Early cement used on three-story warehouse helped save time, labor and cost!

PLANS called for three-story concrete frame warehouse with concrete floor slabs. Dahl-Stedman Company, the contractors, specified Atlas High-Early cement and *saved in these ways:*

THEY SAVED TIME. The superintendent states that Atlas High-Early cement cut the time for completion of this project approximately 50%.

THEY SAVED FORMS. By using Atlas High-Early cement, they were able to strip forms in from three to four days. With regular portland cement it would have been necessary to wait about seven or eight days before forms could be stripped. This made possible a 50% saving in forms and form lumber.

Atlas High-Early cement can save time and dollars for you . . . Atlas High-Early cement gains working strength rapidly—often cuts time for protection and curing as much as 60% to 70%. In many cases it permits early stripping of forms for re-use and results in a substantial saving in form costs. Atlas High-Early cement also more than pays for its slight extra cost on many jobs. It will pay you to consider it for *your* next job. Universal Atlas Cement Company (United States Steel Corporation Subsidiary), Chrysler Building, New York City.

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ENR-H-43

ATLAS HIGH-EARLY CEMENT

A UNIVERSAL ATLAS PRODUCT

The Week In Engineering and Construction

ENGINEERING NEWS-RECORD • JUNE 18, 1942 • VOLUME 128 • NUMBER 25

Construction industry to be covered by price regulation

OPA expected to issue interpretation of general maximum price regulation bringing industry within order's bounds. Supposed exemption clause misinterpreted

Construction is going to be covered by a price ceiling. The Office of Price Administration will shortly issue an interpretation declaring that the construction industry is covered by last month's general maximum price regulation.

The industry has generally assumed that it is excluded by a clause exempting services concerned solely with real property. It was not, however, OPA's intention to exclude construction (the clause actually covers title searches and the like), and it will so declare.

Construction difficult to price-fix

This, of course, leaves wide open the question of how to determine the ceiling price on construction. The general regulation sets every man's ceiling price at the price he received in March. This means little in the case of construction.

Therefore, OPA is preparing a supplement to the general maximum price regulation which will set up a formula for the pricing of construction. As may be imagined, this has proved a tough job. Several dozen drafts of the order have been prepared and torn up. The final decision as to how to do it has not yet been reached.

Formula on cost-plus basis

Present probability however is that a formula will be adopted which will, in effect, price all construction on a cost-plus basis. That is, the ceiling price for any construction job would be the cost of materials (already held down by a price ceiling) plus labor at the wage rates in effect as of some date—probably March—plus a certain percentage.

One possibility would be to make this percentage the margin above costs obtained by each individual contractor in March. It is likely, however, that instead OPA will issue a schedule of allowable percentage mark-ups. The percentage would vary according to the size of the job—a large percentage on small jobs, a small percentage on big jobs.

A further complication will probably be introduced in order to preserve the possibility of fixed price contracts even though the ceiling is set on a cost-plus basis. It would be permissible to make a fixed price contract provided it did not exceed the estimated cost plus the OPA determined percentage. Then, if the actual cost varied from the estimated cost by more than a certain percentage, the price would have to be adjusted at the end of the job.

When the pending order is issued it will unquestionably contain a clause validating existing contracts. Some OPA price orders have cut across existing contracts. And, technically, nearly all construction contracts made since the price freeze became effective May 11 are in violation of the law. But OPA officials recognize that the general maximum price regulation was ambiguously worded and could be honestly misinterpreted. In any case, there has been no means by which a construction contractor could obey the law even if he considered himself covered.

Until the new regulation comes out, contractors are probably entirely safe in continuing to make contracts in the usual fashion.

Equipment men convert to maintenance

Servicing and reconditioning of construction equipment used on war projects, rather than selling will be the principal job of the members of the Associated Equipment Distributors for the duration of the war, according to the opinions prevailing at the organization's semi-annual meeting in Chicago, June 8–10.

These services of shop and personnel were described by Army and Navy representatives as a vital war contribution. Discussion of the rental rates for equipment was extensive, with some criticism of minor details, but they were generally regarded as satisfactory. Mutual problems of the distributor and manufacturer were aired in joint sessions, as were questions relating to interpretation of wage and hour conditions.

In addition to servicing equipment now in use, either directly by the armed forces or by contractors working on war projects, the distributors are expected to be the natural agency for locating, reconditioning and reselling the used equipment that is available in private or public construction organizations. The rates for purchase and resale (55 percent of original price for purchase and 85 percent for resale, as rebuilt) were the subject of much discussion, and the general opinion indicated that the spread was not sufficient for an adequate job of reconditioning.

Major Robert L. Richardson, chief, mechanical equipment section, Office of the Chief of Engineers, reviewed at length the position of the Army in its need for equipment. It was his opinion that the distributors would be able to provide the necessary servicing facilities. However, he warned that this service would have to be offered at prices which were less than what it would cost the Army to do the same work. He stated that district and area engineers had already been instructed to use these facilities, and that it was up to the local distributors to "sell" these army engineers on the economy of using these services with the maintenance funds now authorized.

Representatives of the Navy Department indicated that the same arrangements could be made with its Civil Engineer Corps officers by local distributors.

The history of the A.E.D. was related by Morton R. Hunter, one of the six founders and president in 1925. A report on membership showed a healthy growth among all grades. Announcement was made of the appointment of Paul Cassaday as assistant to C. F. Winchester, executive secretary in the Washington headquarters.

Hartford bridge erection gets under way again

The first span of the 70-300-270-ft. continuous girder unit of the highway bridge at Hartford, Conn. that fell Dec. 4, 1941 has been replaced after an unexpectedly long time due to delay in securing steel. The 270-ft. span was being erected over a single falsework bent 120 ft. out from the pier and was ready for placing of a 96 ft. long, 94 ton section that would have closed the span when it fell into the Connecticut River (*ENR*, Dec. 11, 1941, p. 837) carrying 16 men, including W. J. Ward, erection superintendent, to their deaths. An investigation into the cause of the disaster, made by Prof. Charles M. Spofford of Massachusetts Institute of Technology and a member of the consulting firm of Fay, Spofford & Thorndike, is understood to have been completed but has not been made public.

Contrasting with the first erection attempt over a single falsework bent on wood piling the present erection was accomplished over two falsework bents supported on steel piles driven to refusal through a considerable depth of relatively soft material. The bents used are at 90 and 210 ft. respectively from the shore pier and are each braced to the nearest concrete pier to prevent longitudinal movement of the top of the pile bent. Erection of the final section, 96 ft. long and centilevering half over the next pier, was done in two lifts, with a separation along a horizontal joint made necessary to permit shipment of the 17-ft. deep section by rail. This reduced the weight of the closing section and was used for added safety although the second falsework bent was almost exactly under the mast of the erection traveller.

The approach spans on both sides of the river have been erected but the bridge still lacks erection of the 300-ft. center span (longest American girder) and the other 270-ft. span for completion. They will be erected as soon as the falsework just used can be withdrawn and moved ahead.

Opening of the bridge is now scheduled for Labor Day, Sept. 7, after which it will be operated as a toll bridge by the Connecticut Highway Department.

The structure was designed by Robinson and Steinman of New York who are now acting as erection consultants for the Connecticut Highway Department (*ENR*, June 11, 1942, p. 954).

The superstructure is being erected by the American Bridge Co. under supervision of D. M. Woods.

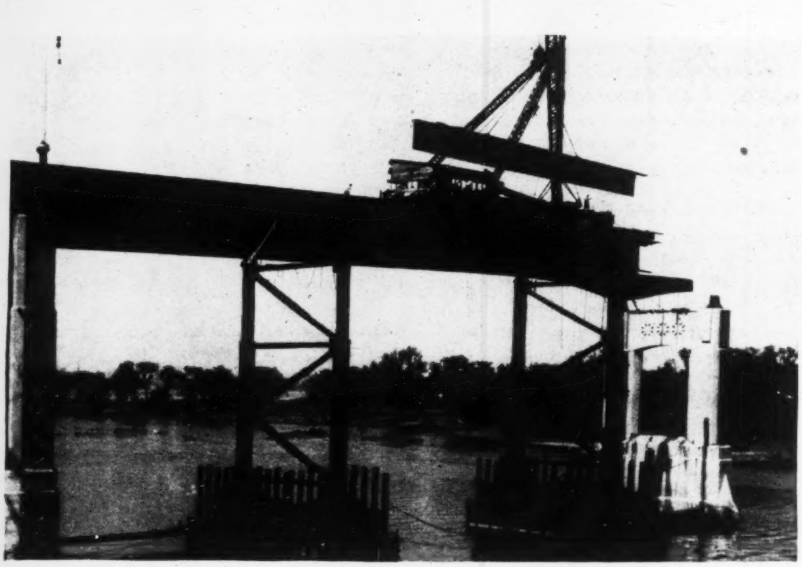
• • •

American-Canadian flow charts scheduled

Coordination of stream flow information vital to the war production programs of the United States and Canada has been arranged between the Geological Survey and the Dominion Water and Power Bureau.

The monthly report of current stream flow conditions in the United States, will be extended to include data from the Canadian side of the international boundary. Under the new plant the monthly report will be compiled in Washington from data furnished by both the United States and Canadian district engineers. It will include their comments in any over-all statement by the Survey or the Water and Power Bureau, on the condition of flow. The report, including the map of the United States and a portion of Canada from which data are furnished, will be printed in Washington and a supply sent to Ottawa for distribution.

This survey is expected to serve a useful purpose in making available to interested parties in both countries prompt information in regard to runoff conditions on a continental basis.



Two bents of falsework are used in new erection schedule for Hartford Bridge

WASHINGTON HIGHLIGHTS

By The Middle of next month construction will start on a 550-mi. oil pipeline stretching from Texas oil fields to the Salem, Ill., area, as a part of Petroleum Coordinator Ickes' program to bring additional supplies to the rationed East. Turned down three times by WPB and its predecessor, SPAB, the line has finally been approved and is to be built by the Defense Plant Corporation—an RFC subsidiary—in conjunction with a committee of petroleum firms organized as "Eastern Oil Industries." W. Alton Jones of Cities Service Co., is president of the petroleum group. The line will form one leg of a much longer proposed pipeline from Texas to New Jersey, still being pushed by Ickes. The full project has not been approved by WPB, but it is still under study and there is a chance that by the time the Salem line is finished, WPB might find the steel for the larger project. The Salem line is to be 24 in. in diameter, of $^3/_8$-in. seamless steel tubing, with welded joints. It will require 125,000 tons of steel, although at certain points cast iron pipe will be substituted for steel. Ten pumping stations will be built at 55-mile intervals. Capacity will be 300,000 bbl. of crude oil per day.

Aerial surveys of the route have been completed and ground surveys are now under way.

Present policy of holding down expansion of new plant will not seriously affect the volume of construction this year, it now appears, but the affect will show up in 1943. This confirms statements made in these pages (*ENR*, May 21, p. 51) when the policy first was made public. After a re-examination of pending work in the light of the new policy, WPB officials estimate 1942 construction volume at thirteen and a half billions as compared with earlier estimates of about fourteen billion.

Track-Laying tractors may no longer be sold except on specific authorization from the War Production Board. This is ordered in an amendment of Order L-53, which previously permitted sale on A-1 priority ratings or in accordance with orders placed prior to February 19.

AGC board meeting reflects extent of industry's confusion on regulations

Board finds few solutions for pressing problems incident to priorities, labor rulings and varying contract procedures; notes Army aid

American contractors have made a remarkable construction record on war work during the past year despite, rather than because of, the numerous efforts by the federal government to provide means of speeding operations, it became apparent at the annual Spring meeting of the board of the Associated General Contractors of America.

Held in Chicago for three days last week, the meeting served to bring into sharp focus the myriad problems facing contractors in a strictly controlled market and economy, although it produced little in the way of solutions for those problems.

H. E. Foreman, managing director, keynoted the session with the admonition that the industry must continue its present record-breaking pace despite any and all difficulties.

"The immediate job ahead is to continue breaking speed records in constructing the remaining facilities needed for the war effort," Mr. Foreman said. "This must be done at a time when production of much construction equipment is shut off and when there are increasing shortages of basic materials.

"At the same time, the industry must look to its public relations so that the public will understand what has been done and will entrust us with the work needed in the future. And, the industry must prepare for the post-war period when it will be expected to take a leading part in the return to peaceful pursuits. "In many respects, the problems of peace will be bigger and more complex than those of war."

Major problems of contractors

Three major problems were shown to be thorns in the industry's side.

Of first importance was what some members called the government's vacillating attitude on the labor matters—an attitude that was charged with confusing the current labor situation.

Members and chapters reported that talk of wage ceilings had resulted in an "understandable effort" on the part of labor to demand higher wage rates before any freezing of wages is placed in effect.

The board recommended that no further wage negotiations be made by members or chapters pending expected freezing action by the War Labor Board.

It was noted that for the most part labor has cooperated with contractors in the war effort, adhering to the AFL-OPM agreement made last fall particularly as to payment of overtime. However, several members reported that on privately-owned but government-financed war plants, labor has refused to regard the work as federal, and is demanding double time for overtime.

Secondly, contractors told of worry and confusion over systems of letting contracts. Members of the AGC said they have seen this procedure change from lump-sum unit prices, to negotiated fees, back to lump sums, to Architect-Engineer-Management lump sum, and now to A.E.M. negotiated fee. That there is no uniform basis for A.E.M. contracts was shown by reports from six contractors—all holding such contracts but operating them differently.

Greatest worry at the moment appears to be new regulations that provide for re-negotiation at any time within three years after the contract is completed. The group felt these provisions would lay members open to future political investigations, and open up the possibility of persecution because of alleged excess profits on one job without any account being taken of contemporary jobs on which no profits were made, or actual losses sustained.

A staff report on priorities showed confusion in the materials situation, too. Principal factor brought out was that receipt of a preference rating by a contractor does not guarantee delivery of materials.

Price control is another phase of materials procurement that is bothering the group. In fact, it was said, some contractors are wondering if price control applies to contractor services—that is, if they will be held to bid prices on certain dates in the past as maximums for similar work in the future.

The equipment situation is being eased a little by the efforts of the Corps of Engineers to make its own equipment available to contractors whenever possible. It was reported that the Corps of Engineers now own construction equipment worth $90,000,000, and is setting up six district coordinators for effective use and distribution of this vast reservoir of machinery. Repair parts are almost impossible to obtain now, according to the contractors.

Some trouble is being experienced with the ODT order on truck haulage, requiring 75 percent loads on return trips. This is affecting truck delivery of materials to jobs where there is no possibility of return loads from the area. Contractor-owned or leased trucks are not affected by the order.

At the spring board meeting last year, A. P. Greensfelder proposed a construction institute that would carry on research in construction markets, materials and procedure, to be financed by income from an endowment fund. At the Chicago meeting reports of subscriptions to the institute fund were regarded as so disappointing that the board voted to discontinue the plan, release members from all pledges made and to return any funds actually paid in.

H. E. Foreman (left), managing director; O. B. Coblentz (center), vice-president and Dan Kimball, president, confer at Chicago AGC board meeting.

Northwestern Technological Institute dedicated with elaborate ceremonies

Two-day conference attended by 1,000 representatives of industry, science and education opens $5,000,000 building in Evanston

A new outpost on America's "Science Front" was dedicated June 15-16 at Evanston, Ill., at the formal opening of the new $5,000,000 building of the Northwestern Technological Institute. The ceremonies included a two-day series of educational and industrial conferences attended by more than 1,000 engineers, scientists and educators from all over the country. Principal speakers at the conferences included Donald M. Nelson, chairman of WPB; Lt.-Gen. William S. Knudsen; Secretary of Commerce Jesse L. Jones; Charles F. Kettering of General Motors; Gov. Dwight Green of Illinois, and Martin W. Clement, president of the Pennsylvania Railroad. Franklyn B. Snyder, president of Northwestern University, welcomed the delegates at the opening session.

The dedicatory convocation was held Tuesday afternoon, June 16, before 2,000 guests. Keys to the new building were formally accepted by Kenneth F. Burgess, president of the Northwestern board of trustees, who presented them to Dean Ovid W. Eshbach of the Technological Institute. The convocation address was given by Secretary of Commerce Jones.

Founded through gift

The Technological Institute was established in 1939 through a gift of $6,735,000 from Walter P. Murphy, Chicago manufacturer of railroad supplies. The new building containing 10 acres of floor space, was started April 1, 1940 and was completed early this year after some delay due to a disastrous fire in December 1940. The structure was designed by Holabird & Root, architects of Chicago, and was built by R. C. Wieboldt, general contractors of Chicago.

The building consists of a central structure with six wings, housing the departments of physics and chemistry of the university and the departments of civil, mechanical, electrical, and chemical engineering of the Institute. The central structure contains the main auditorium, lecture rooms, the central library and the administrative offices.

Approximately $1,000,000 worth of new scientific equipment for teaching and research has been installed. Among unusual installations are a 5,000,000-lb. hydraulic testing machine; a 1,000,000-lb. testing machine, a soundproof room; a cold room for full-scale research at temperatures to 75 deg. below zero; an artificial river for testing boat models and wave action; and equipment for producing artificial rain and lightning for testing insulation.

The Institute operates on the co-operative plan, under which students alternate a three-month period of study on the campus with an equal period of work in industry. Seventy large industrial firms in 12 different states co-operate in this program. The present enrollment of 525 will be increased to 800 in the fall.

A large amount of vital war research is already being carried on by the Institute. A naval radio operator's training school opened on June 1, and will have an enrollment of 1,000 by September. About 600 students are also being trained in night classes for work in war industries.

• • •

Reappoint Virginia Road commission head

Brigadier Gen. James A. Anderson, formerly dean of engineering at Virginia Military Institute, has been reappointed to the position of state highway commissioner.

In his capacity as commissioner, General Anderson will act as chairman of an expanded 9-man commission. The present commission is made up of five men, but Governor Colgate W. Darden, Jr. is empowered under a 1942 legislative act to add four more members.

Appoint FWA director for Midwest area

The appointment of Linus C. Glotzbach of St. Paul and New Ulm, Minn. as regional director of the Federal Works Agency for nine states west of the Mississippi was announced last week. The appointment and establishment of the region was a part of a general decentralization program undertaken by the FWA (*ENR*, June 4, p. 897 and previous).

The new region embraces Minnesota, Iowa, Missouri, Kansas, Nebraska, North and South Dakota, Colorado and Wyoming. Headquarters are at St. Paul.

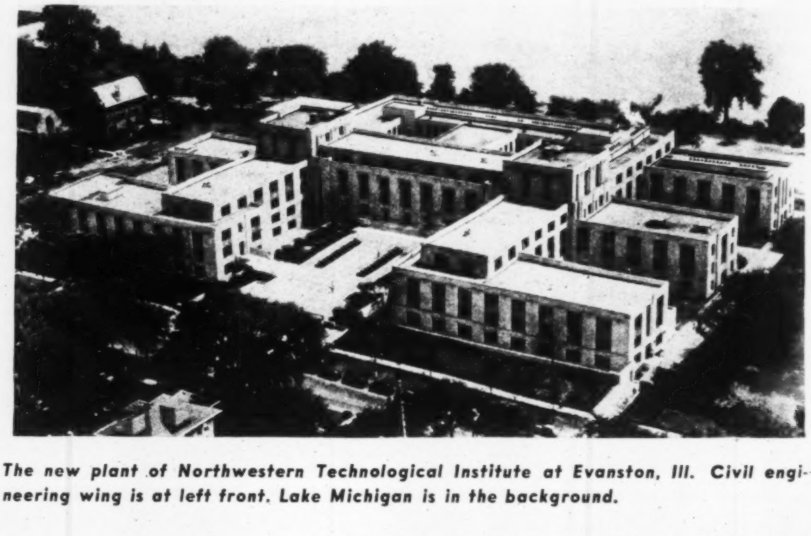
• • •

Higher rating given for Philadelphia water job

The War Production Board last week notified Philadelphia city officials that it had granted an overall A-1-j rating for the city's $18,000,000 water system improvement program. (*ENR*, June 11, p. 955 and previous.)

Previously, the project, which includes installation of new pumps, new pipes, and other material to increase the capacity of the system by 10 percent, was granted an A-4 priority, with special A-1-c for certain materials on the critical list, including copper and brass.

John H. Neeson, director of public works, said that contracts will be let within the next two months to round out the first phase of the program covered by an initial bond issue of $7,000,000. This phase includes new pumps for the Lardner's Point and Torresdale stations, preliminary mechanical filters and chemical treatment equipment for the Torresdale and Queens Lane plants, and electrical equipment installations for a proposed new pumping station.



The new plant of Northwestern Technological Institute at Evanston, Ill. Civil engineering wing is at left front. Lake Michigan is in the background.

New York license board approves plan for "engineer-in-training" examination

Follows May action permitting applicants for licensing as professional engineers to take tests before acquiring field experience

The New York State Board of Examiners of Professional Engineers, at a meeting held last week, approved a plan for inaugurating examinations for "engineers-in-training" in June, 1943.

In May the board adopted the general principle of permitting applicants for licensing as professional engineers to take written examinations in the fundamentals of engineering in advance of their having acquired the necessary practical experience (*ENR*, May 14, p. 817). Conditions were to be defined at a later date.

The new action of the board defines those conditions and sets the month in which the first examinations will be held. Prescribed written examinations for a license as a professional engineer will be divided into preliminary examinations and final examinations, of which the former may be taken prior to completion of the statutory qualifications for license. The preliminary examinations initially will consist of Parts I and II of the present examinations for professional engineers. The final examinations will consist of Part III of the present examinations.

After Jan. 1, 1943, the board will receive applications for separate admission to the preliminary examinations; applications must be filed not later than May 1 or Dec. 1, respectively, for admission to the June and January preliminary examinations of any year.

Candidates must be at least 21 years of age, must satisfy the citizenship requirement of the law and must have endorsements of character and aptitude from three or more registered professional engineers who are personally acquainted with the applicant and his record. The board's plan sets forth the conditions under which the graduates from approved engineering schools and candidates who are not graduates of such schools may be admitted to the examinations.

Candidates successfully passing both parts of the preliminary examinations will be so certified by the Department of Education and will be recorded for a period not exceeding ten years as engineers-in-training for future qualification as professional engineers. Thereafter, "four years of satisfactory engineering experience showing breadth and progression, as defined in the published rules of the board, in addition to the prescribed qualifications for admission to the preliminary examinations, will be required for admission to the final examinations."

Candidates failing in either parts of the preliminary examinations will receive no credit until both are passed in a single examination period. The application and examination fee for the preliminary examinations is set at $15, which will be credited toward the statutory fee of $25 for license as a professional engineer.

• • •

Kentucky P.S.C. fails to act on utility purchase

The Kentucky State Public Service Commission ruled last week that it was without authority to pass judgment on a petition filed by five cities seeking to acquire electric distribution facilities from the Tennessee Valley authority. (*ENR*, June 11, p. 959). The commission also ruled it had no jurisdiction over bonds the cities have issued to finance the purchase.

The five cities—Bowling Green, Hopkinsville, Russellville, Murray and Mayfield—recently participated in an agreement between themselves, TVA and two rural electrification districts for the purchase of facilities of the Kentucky-Tennessee Light & Power Co. The municipalities' share of the purchase price will be $2,122,000.

Noting that the Kentucky-Tennessee company never petitioned the commission for authority to sell its properties, the P.S.C. inserted a statement in its ruling inferring that it still has judisdiction over the right of a company to sell its property to "any person, firm, corporation or agency."

• • •

Colonel Hannum raised to brigadier general rank

Latest roster of the Corps of Engineers reveals that Colonel Warren T. Hannum, division engineer, South Pacific Division, San Francisco, has been advanced to the rank of brigadier general.

Born in Pottsville, Pa., in 1880, General Hannum graduated from West Point in 1902. Throughout his long career he has become one of the best liked and most capable officers of the Corps, and occupied many important posts.

As a captain (1910-12) he was officer in charge of engineering work in Washington, D. C., including the Washington aqueduct and filter plant. Later he served in Hawaii and Cuba, and during the World War commanded the 308th Engineers in the Aisne-Marne offensive. General Hannum returned from France as a member of the General Staff, A.E.F.

He has since been district engineer at Baltimore, division engineer in New Orleans, and a member of the Board of Engineers for Rivers and Harbors. From 1935 to 1938 he was chief of the military division in the Office of the Chief of Engineers, and since then has occupied his present post at San Francisco, which covers not only the San Francisco and Los Angeles districts but Hawaii as well.

Press Associations photo

Bad going on the Alaska Highway

Difficulties faced by the Corps of Engineers, U. S. Army, in building the pioneer road for the Alaska Highway are clearly shown in this photo. It was taken north of Ft. St. John, British Columbia, where this highway runs through the forested plains at the headwaters of the Peace River. Farther north the road runs into rough mountainous country. The Army engineers are building the pioneer road over which contractors, working under the direction of the Public Roads Administration, will bring in supplies for the permanent road.

Self-powered concrete ships added to Maritime Commission program

With concrete barge program actively under way, commission lets contract for 24 ships of 5,200 tons for use in coastwise service

The Maritime Commission has awarded contracts for its first self-propelled concrete ships. Contract for 24 of these vessels, of 5,200 tons deadweight, was awarded last week to McCloskey & Co. of Philadelphia, which plans to build the ships in a new yard to be constructed at Tampa, Fla.

The first ship is to be completed before the end of the year, and the rest during the first half of 1943.

It is not expected that any further contracts for powered concrete vessels will be let until performance of these ships has been tested. However, need for coastwise transportation and the developing shortage of steel plate may force a change in this intention. The Commission pointed out, in making the award, that its decision to build these ships is based on the belief that the presently scheduled ship-construction program will use nearly all the available steel.

The new ships, which have an over-all length of 360 ft., as compared to 350 for towed concrete barges (of which 33 are now under contract) have a slightly smaller tonnage than the barges. The shape of the hull has been considerably changed from that set for the barges to adapt it to self-propulsion. The vessels are to have single-screw drive powered by reciprocating steam engines of a type similar to those used in the Liberty freighters, though somewhat smaller. The new self-propelled ships, it is expected, will be used for the same type of coastwise traffic for which the concrete barges are intended.

Rather more use is to be made of modern methods of concrete placement and design than was encouraged in connection with the barge program. On that program, the Commission insisted that no methods be taken account of in design which had not been tested in ship construction in the last war.

It is understood, without official confirmation, that use may be made of pneumatic placement of concrete on the new ships.

The Maritime Commission, meanwhile, is studying plans for the construction of small-shallow draft concrete barges for use on inland waterways and the inside passage along the Atlantic Coast. The barges being built under the present program require deep water for their operation.

• • •

OPA freezes price of concrete reinforcing bar

Price of fabricated concrete reinforcing bars was frozen by the Office of Price Administration last week at a basic level of \$2.40 per 100 lb., plus freight. The freeze, incorporated in Regulation 159, is intended to give fabricators a margin of 50¢ per hundred pounds over the mill price of bars—already frozen at \$1.90.

The \$2.40 price applies to deliveries everywhere, except in the state of Michigan and at Toledo, Ohio, unless the bars were bought by the fabricator at the Gulf port or Pacific Coast basing point prices, in which case the price is \$2.77 and \$2.80 respectively. Carload price for deliveries to Toledo and Michigan points is \$2.57, except at Detroit, where it is \$2.52. Customer is to pay freight charges from mill to fabricator and from fabricator to the customer.

Chicago suspends assistant city engineer

Arthur E. Gorman, assistant city engineer in Chicago, was suspended June 12 by Oscar E. Hewitt, commissioner of public works. No reason for the action has been given other than "for the good of the service". Mr. Gorman has refused to comment.

Informed sources believe that the suspension resulted from a disagreement relating to personnel in the water purification division of the department. Mr. Gorman has been in charge of the work connected with the design and construction of Chicago's new water filtration project.

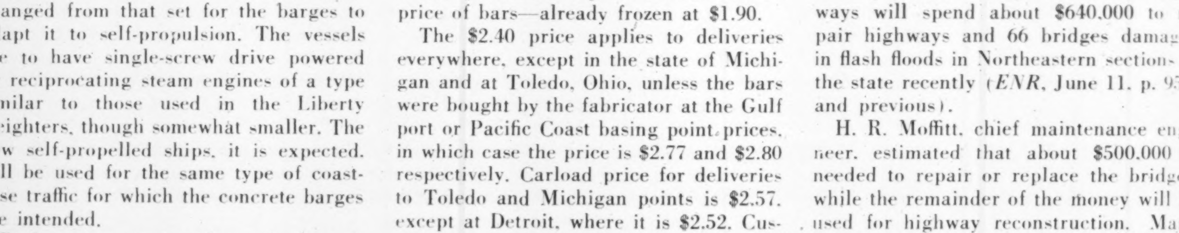
Under civil service regulations the commissioner must lift the suspension or prefer charges within 30 days. Mr. Gorman has been an employee of the city since 1924, except for the period 1928 to 1931, when he was engaged by the Sanitary District of Chicago and also in equipment sales work. Long associated with waterworks developments in the city, he was appointed assistant city engineer in 1941, to give him more responsibility in connection with the development of the filtration project plans.

• • •

Flood damage repair to cost \$640,000

Pennsylvania's Department of Highways will spend about \$640,000 to repair highways and 66 bridges damaged in flash floods in Northeastern sections of the state recently (*ENR*, June 11, p. 954, and previous).

H. R. Moffitt, chief maintenance engineer, estimated that about \$500,000 is needed to repair or replace the bridges, while the remainder of the money will be used for highway reconstruction. Many of the steel bridges must be repaired by makeshift means until steel is again available.



Louisiana water and sewage works operators go back to school

Despite tire rationing and the special demands on time these days, seventy-five waterworks and sewage treatment plant operators from all parts of Louisiana attended a short course held in Baton Rouge recently. Sponsored by the State Department of Health, the course was designed to acquaint the men with the latest developments in operating practice, according to F. McDonald, head of the Water Supply and waste disposal section of the department. Examinations were given for certification of water plant operators and plans were developed for a certification program for sewage plant operators.

OBITUARY

Louis Quien, Jr., 63, an architect and civil engineer of Elizabeth, N. J., died there June 14.

William H. Cramer, 54, assistant county engineer for Jasper county, Iowa, died recently at his home at Newton.

Benjamin F. Taylor, 60, senior engineer for Division 5 of the Public Roads Administration at Omaha, Neb., died there recently.

Kennerley Robey, 72, Fort Worth Tex., civil engineer who laid out the Fort Worth stockyards and was employed on the original levee work around the city, died June 7. Mr. Robey, a graduate of Cornell University, did engineering work in Alaska before he was employed by Swift & Co., for whom he worked for 25 years.

Harry Wendell Mahon, 53, for the past 23 years engineer for the Nova Scotia Power Commission, died June 8.

George A. Jelden, 68, for more than 40 years an employee of the Philadelphia Bureau of Engineering, Zoning and Surveys, died June 8 at Germantown, Pa.

John C. McCarrell, retired district engineer for the Pennsylvania state highway department, died at Linglestown, Pa., June 11. He had been an employee of the department from 1907 until June 1 of this year, when he retired.

Chester Waters Larner, 61, internationally known hydro-electric engineer, died June 11 at Germantown, Pa. He was credited with revolutionizing phases of hydro-electrical engineering through the invention of the Larner-Johnson valve.

Thomas B. Slade, 68, civil engineer with the Florida state highway department, died June 8 at Deland, Fla.

George Brick Smith, 47, cost engineer in the production department of the Newport News Shipbuilding & Drydock Co., died recently. He was a marine engineer and naval architect.

Wallace Carl Riddick, 77, dean emeritus of the School of Engineering at North Carolina State College, Raleigh, N. C., died June 9 at Baltimore, Md. He joined the staff in 1892, and became president of the school in 1915. He served in that position until 1923. He had been dean emeritus since 1937. An able consultant and engineering educator, Dr. Riddick served on many public and private projects in the state, among them the rebuilding of the water system of the city of Raleigh; the state highway commission from 1915 to 1919. He was a former president of the North Carolina Society of Engineers.

Leigh Vernon Farnham, 50, formerly a civil engineer for the town of Lexington, Mass., and recently on the engineering staff of E. B. Badger & Sons Co., Boston, died at Boston June 7.

Thomas H. Gothard, 67, former superintendent of water mains for the Light, Gas and Water Division, of Memphis, Tenn., died June 8.

W. C. Sloan, 55, assistant vice president and general manager of the western lines of the Northern Pacific Railway, died June 6 at San Bernardino, Calif. He began railway work in 1907, and joined the Northern Pacific staff in 1909 as an inspector in the engineering department.

Frank Arrigoni, 68, of Durham, Conn., president of Frank Arrigoni & Sons, road builders, died at Durham June 12.

William T. Carlson, 69, building contractor of Brainerd, Minn., died at his home there recently.

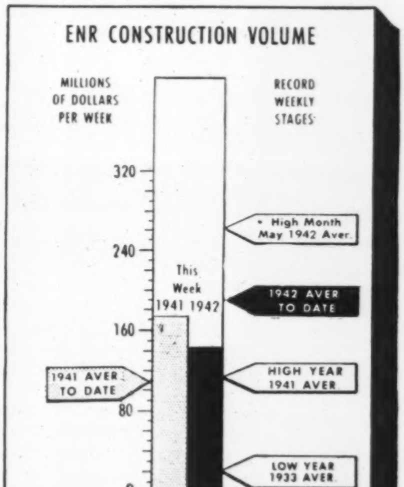
William H. Anderes, 59, prominent general contractor at Wausau, Minn., died June 6.

Robert Lawton Dyer, 40, an engineer for the Puget Sound Bridge & Dredging Co., died June 8 at Medina, Wash. He had been employed by the company at Sitka, Alaska, until two months ago.

CONTRACTS AND CAPITAL

ENGINEERING construction volume for the week totals $155,670,000, a decrease of 59 percent from the preceding week, and 10 percent under the total for the corresponding 1941 week. Public construction, which accounts for 93 percent of the total, is 61 percent below last week, and 7 percent below last year. Private work tops the preceding week's volume by 91 percent, but is 40 percent lower than a year ago. The current week's construction brings 1942 volume to $4,746,455,000, an increase of 76 percent over the total for the 25-week period last year. Private work, $333,688,000, is 54 percent lower than in the period a year ago, but public construction, $4,412,767,000, is 123 percent higher as a result of the 207 percent increase in federal work.

In the classified construction groups, gains over last week are in waterworks, industrial buildings, earthwork and drainage and unclassified construction. Increases over the 1941-week totals are in waterworks, industrial buildings, and unclassified construction.



New capital for construction purposes for the week totals $1,795,000. This compares with $23,150,000 for the week in 1941. The current week's financing is made up of $1,720,000 in state and municipal bond sales, and $75,000 in corporate security issues.

New construction financing for the year to date, $6,872,345,000, is 106 percent higher than the total for the corresponding 1941 period.

CONTRACTS

(Thousands of dollars)

	Week Ending June 19 1941	June 11 1942	June 18 1942
Federal	$128,310	$362,627	$136,232
State & Municipal	26,375	10,962	8,231
Total public..	$154,685	$373,589	$144,463
Total private.	18,621	5,869	11,207
TOTALS	$173,306	$379,458	$155,670
Cumulative			
1942......(25 weeks).....			$4,746,455
1941......(25 weeks).....			$2,697,883

Note: Minimum size projects included are: Waterworks and waterways projects, $15,000; other public works, $25,000; industrial buildings, $40,000; other buildings, $150,000.

NEW PRODUCTIVE CAPITAL

	Cumulative 1941 25 weeks	1942 25 weeks
NON-FEDERAL ...	$437,381	$333,390
Corp. Securities..	133,625	136,459
State & Mun.....	241,904	149,512
U.S.H.A. loans...	30,399	....
R.F.C. loans.....	31,453	47,419
FEDERAL	$2,891,337	$6,538,955
TOTAL CAPITAL..	$3,328,718	$6,872,345

ENR INDEX NUMBERS

Index Base = 100		1913	1926
Construction Cost..	June '42..	274.19	131.80
Building Cost......	June '42..	221.18	119.56
Volume	May '42..	821	360

FHA MORTGAGES

	Week Ending June 14 1941	June 6 1942	June 13 1942
Selected for appraisal			
Title II...	$32,288	$9,512	$8,008*
Title VI...	$ 8,241	$12,833	$12,131*

* Subject to revision.

Comment and Discussion

Readers' opinions on matters that concern engineers and contractors

Refinement in Design To Conserve Materials

Sir: The letter from E. R. Osgood (*ENR* Apr. 23, p. 602) brings up a matter which should be given serious thought by leaders of the engineering profession in our country, particularly civil and mechanical engineers. The value of advanced stress analysis work has long been recognized in aeronautical design, and stress analysts are hired as such. The civil engineer does not use advanced stress analysis in the design of his structures and regards stress analysis as a minor feature of civil engineering. The undergraduate training of the civil engineer gives him only a meager introduction to stress analysis yet fills him with the belief, upon graduation, that he knows all of the stress analysis that is needed to design structures. He seldom returns for graduate study to find the truth about how little he really knows about stresses.

In peacetime, structural engineers design structures with undergraduate formulas and defend their lack of use of advanced stress analysis by an argument which seldom contains an admission of ignorance but always contains the following equation:

1 hr. of labor = 20 lb. of steel.

This equation is true in the United States during peacetime but does not hold in other parts of the world. During a war, labor and steel are not related, each being a function of the available supply.

From the reinforced-concrete structures being built in the war program today, 25 percent of the steel could easily be eliminated by an expert stress analyst. Today when we need expert stress analysts to eliminate steel from reinforced-concrete structures none are available. This lack is probably due to the reluctance of managers of engineering organizations to admit the need of expert stress analysts in the design work of their organization during peacetime. The frequent statements by outstanding engineers that there is little value to be gained in the designing of structures from the application of advanced mathematics in stress computation is the cause of the lack of development of graduate training in advanced stress analysis in our American universities.

The universities will respond to whatever demands are made by the engineering profession for advanced education in any specialized field. As an example there has been offered during the past year at Brown University advanced training in all fields of engineering mechanics and related mathematics under the sponsorship of the U. S. Office of Education as part of the war program, tuition being paid for by the government. Many of the world's best authorities have been gathered for this training program and it represents by far the most outstanding effort of this sort ever made in the United States. It is interesting to note that the U. S. Office of Education has realized the value of a training program in advanced mechanics, yet government agencies have not apparently developed such a realization as evidenced by the few young men being sent to Brown University. Statistics would be very interesting that show the number of men being sent back to the universities at full salary by both private and government agencies. Government agencies should be sending at least a hundred young men back to school each year for graduate study in advanced mechanics and mathematics. This is the phase of engineering knowledge that cannot be gained by experience.

STANLEY U. BENSCOTER
U. S. Engineer Office
Vicksburg, Miss.

Saving Reinforcing Steel

Sir: The article "Saving Reinforcing Steel by Rationalizing Safety Factors," by A. G. Boase, in *Engineering News-Record*, May 7, 1942, p. 785, proposes a wholly justifiable method for effecting economy of material.

Nearly 50 years ago, in his *General Specifications for Steel Railroad Bridges and Viaducts*, Theodore Cooper recognized the propriety of using different safety factors for dead-load and live-load stresses. He prescribed a unit stress for dead load double that for live load. The usual procedure in practice under these specifications was to apply the live-load unit stress to the quantity (live-load stress + ½ dead-load stress), instead of to the quantity (live-load stress + 7/10 dead-load stress) as suggested by Mr. Boase. The latter is equivalent to using a live-load unit stress of 20,000 psi. and a dead-load unit stress of 28,570 psi.

The latter may be considered a little too high. In Mr. Cooper's *Highway Specifications* of 1909, the tensile unit stresses prescribed were respectively 12,500 psi. and 25,000 psi. If, by the method of Mr. Boase, the live-load unit stress were reduced to 18,000 psi., the corresponding dead-load stress would be 25,710 psi.—a more conservative figure. The proper values to recommend are, of course, a matter of engineering judgment, but the principle involved is sound.

The proposal of Mr. Boase is one more reminder of the old saying "There is nothing new under the sun."

FRANCIS P. WITMER
Director of Civil Engineering
University of Pennsylvania
Philadelphia, Pa.

Pre-Assembly Not New

Sir: Referring to the editorial "Pre-Assembly Now Standard" in your issue of May 21, one should not infer that this (pre-assembly) is a new principle, or that the construction and shipbuilding industries had been asleep up to the present emergency. The following from the personal experience of the writer will prove the point.

Previous to our entry into World War I the writer was sent out as assistant engineer on a bridge for the Boston and Maine R. R. over the Hudson River above Troy, N. Y. It consisted of replacing under traffic an existing nine-span double-track deck structure. The pre-assemblies used, while few in kind, were many in number. The main one consisted in assembling with a "whirly" along the dead track, full panels of stringers, cross frames and laterals. These in turn were picked up and set by the derrick car which did the main erection.

The stringers were cambered, and half the camber in turn was taken out in the dap of the ties. This gave a change in dap about every fourth tie. These ties were framed along the dead track, the daps being marked on the butts. They were then piled up by panels in such order that, when picked up by the derrick car and deposited in the center of a panel, they could be divided in the middle and rolled two ways to the ends, and the ties would automatically be in their correct locations. Very seldom was it necessary to shift two ties.

The writer feels sure that these two ideas materially assisted in cutting the cost and expediting the completion of the work. Later he wrote an article describing the job, and this article appeared in the old *Engineering Record*.

With regard to the shipyards, the writer believes that the original methods of American shipyards were influenced by the English and Scotch workers who came here. It would seem that the foreign method was to fabricate all steel in the shops and send it to the ways for assembly. Later, when we entered World War 1, the structural steel fabricators were called on to assist in shipbuilding, and many bridge men went to the shipyards. At this time the same urgency for speed prompted the use of the pre-assembly principle. In the large New England yard with which the writer was then connected, the following were pre-assembled: keelsons, intercostals, floors, frames, deck girders, longitudinals, stern tubes, king posts, boat davits, bulkheads, deck houses, engine room hatches, engine foundations, fantails (stern assemblies), freshwater tanks, gun foundations, hatch girders, masts, and a lot of other things.

In the twenty-five years that have elapsed it is but natural that great progress should be made, particularly as we now have new processes and better tools to work with, but I wish to stress the point that the shipyards have long since given up "the old system of bringing up unprepared materials, piece by piece."

One thing more. The statement that one frequently sees in the nontechnical press that "due to modern methods of construction a ship was only on the ways forty-three days, etc." is rather misleading. While as you say the ways are a "bottleneck," and this is a highly commendable record, it does not mean that a ship is built in that time. It takes no account of the great amount of time necessary to design a ship and draw up the plans, to lay out the lines and make the templets in the mold loft, to fabricate the steel, and build the engines and thousands of other things going into a ship. And after she is launched there is usually considerable work to be done in the wet basin.

Where a yard has a contract for say five or more ships great speed records can be made due to duplication, but should the yard be required to start in and build a new type of ship, that would be another story. A somewhat analogous case would be if a bridge builder, who had spent three months fabricating a bridge and six weeks building it on falsework alongside an existing structure, and then in about three hours between trains rolled out the old bridge and in the new, would claim that he had built his bridge in three hours.

Karl W. Lemcke
Flushing, N. Y.

Higher Stresses and Steel Savings

Sir: Much has been written regarding the feasibility of increasing unit stresses in order to conserve steel. Many of us have felt that the gain in weight would be substantially less than a proportionate reduction would indicate, because of the use of minimum sections deemed consistent with the best engineering practice. A minimum thickness is used because of deterioration due to exposure, a minimum depth because of deflection, a minimum size because of slenderness-ratio requirements or for stiffness, and a minimum section in any structure because of good judgment.

In many buildings these minimum requirements have sufficient effect to offset materially the gain from increased unit stresses. I have been interested in studying this effect, have computed the shop-bill weights of different classes of modern steel-framed buildings, have redesigned these buildings with increased unit stresses, and have recalculated the weights. Although my studies are by no means exhaustive, the results may be of interest.

For convenience I have arbitrarily chosen to study the effect of increasing the unit stresses one-third. If consistently applied, this should reduce the amount of steel one-fourth. Instead, the reduction is considerably less than 25 percent. Percentages are given also for designs in which unit stresses for compression members remain unchanged while all others are increased one-third. This is in line with the thoughts of many engineers. For any smaller increase in unit stress the benefits would be less, and the designer must decide just how far he should go in saving metal at the expense of safety.

In a 100 x 200-ft. mill building with a monitor, with snow loads, and with a 75-ton traveling crane of 95-ft. span, the original weight was 650,000 lb., but the weight with all unit stresses increased is only 12 percent less, and with all unit stresses but those for compression members increased is only 6 percent less.

In a one-story industrial building with three bays, the roof trusses are of 60-100-60-ft. span, and the trusses of each bent weigh 14,700 lb. The weight with all unit stresses increased is 15 percent less, and with all unit stresses but those for compression members increased is 5 percent less.

In a recent airplane plant with three bays, the roof trusses are of 100-200-100-ft. span, and the trusses of each bent weigh 11,100 lb. The weight with all unit stresses increased is 11 percent less, and with all unit stresses but those for compression members increased is 5 percent less.

In a recent bomber plant, the 300-ft. end roof truss supports an 80-ton canopy door and weighs 200,000 lb. The weight with all unit stresses increased is 15 percent less, and with all unit stresses but those for compression members increased is 10 percent less.

In a 200 x 175-ft. brick-and-stone building three stories high, provision was made for heavy floor loads for trucks and for storage, and the steel frame was designed for the future addition of two more stories. A heavy truss was used where one column was omitted. By increasing all unit stresses, the total weight of 3,800,000 lb. was reduced 17 percent, the beam weight of 1,900,000 was reduced 13 percent, the girder weight of 870,000 was reduced 22 percent, the truss weight of 150,000 was reduced 24 percent, and the column weight of 870,000 was reduced 20 percent. By increasing all unit stresses but those for compression members, the total was reduced 12 percent, the trusses 11 percent, the columns not at all, the beams and girders as before.

Carlton T. Bishop
Associate Professor of Civil Engineering
Yale University

EDITORIALS

VOLUME 128 NUMBER 25

June 18, 1942

Confused but Hopeful Future

Two years ago when the character of our participation in the world war was becoming apparent it seemed likely that the construction industry would be faced with a tremendous job for a short time, and would then sit on the sidelines to watch the facilities that it had built turn out powder and shells and planes and soldiers. In 1940, it seemed that this period of idleness would arrive in the spring of 1941. Next it was prophesied for the following winter; finally for the spring or summer of 1942. It failed to arrive, but attention was focused on it again in May, when announcement was made in Washington to the effect that no more new facilities would be built and that even some now under construction would be stopped. Here was new basis for thinking that the time for a tapering off was at hand. But hardly had Washington made its pronouncement when the three biggest single contracts of the war were awarded, covering an ordnance plant in Kansas, a synthetic rubber plant in Illinois, and an airplane engine factory near Chicago, each far upwards of $100,000,000. Thus the future is as confused as ever, and the key to it, as it has been always, is to do today's job better and faster than it was done yesterday. Then, if the war news can be kept running as favorably as in the past few weeks, thoughts can be turned to the coming of peacetime and the interesting and challenging problems that it promises. The future, despite its uncertainty, is not something to be feared, but to work for.

Procrastination Doesn't Pay

Delaying actions of various sorts have so much to do with decisions about municipal housekeeping that it is no wonder large cities have difficulty in keeping their houses in order. Los Angeles, for example, has for many years discharged most of the city's sewage through a leaky ocean outfall, as a result of which pollution of nearby bathing beaches has become a public scandal. Conditions finally got so bad that the State Department of Public Health revoked the temporary permit under which the sewage disposal plant operates (*ENR* May 28, 1942, p. 885). Now the city is confronted with an emergency that should have been anticipated and remedied long ago. The situation is complex and the background makes a long story, but there never has been any doubt as to the public nuisance nor has there been any lack of engineering advice as to a remedy. A report prepared two years ago prescribed a sewage disposal improvement program that would have cost $32,000,000. Naturally, it required nerve to tackle so large a project, and it was easy for city officials to let the matter drift along without action. Hence the present emergency; and another example of the troubles that follow procrastination on necessary public improvements.

Emergency Roads

Roads for the use of civilians during an emergency, in which main roads might be needed for troop movements or otherwise disrupted by war, have been selected and marked distinctively throughout the whole New York metropolitan area. Developed by the Metropolitan Defense Transportation Committee, a cordinating agency set up by the civilian defense bodies of the three states involved, the plan has possibilities for other centers of population. Looking beyond the war period, selection and marking of secondary routes roughly parallel to the main trunk highways, may serve to relieve growing congestion on main roads. All over the country, people familiar with "back roads" use them to avoid congestion on main highways, and often to save distance. By special marking and some filling in of missing links, much more efficient use of secondary routes should be possible. Also, the time when traffic on main routes reaches the saturation point could be postponed for a considerable period at a fraction of the cost of adding new traffic lanes.

Prestressed Concrete Tanks

Although little-discussed, prestressed concrete storage tanks for oil and gasoline are being built in increasing numbers as a part of the war program. Beyond the fact that some of the tanks are of underground variety, for which concrete may have been chosen for its corrosion resistance, there are two reasons for the adopted design—the shortage of steel plates and the advantages that prestressing offers in reducing cracks in the concrete. The significance of the development lies in the impetus it may give prestressed concrete in post-war construction by making a large number of engineers and contractors familiar with its possibilities. And these possibilities rest not alone in the tank field, but also in structural framing as well.

Prestressed concrete is not particularly new, the theoretical advantage of producing such a high compressive stress in the concrete that no working load can remove it and thus subject the concrete to tension, having been recognized for a good many years. In the tank field, the earliest practicable method, and the one used most widely so far, is the so-called Hewett system, introduced about 20 years ago. In this design the inner half of the tank shell, containing whatever vertical rods are necessary, is built first in conventional forms. As soon as the forms are removed, the shell is encircled with horizontal rods, which are highly prestressed by drawing the rods together with turnbuckles, an action that places a high precompression in the concrete of the shell. A final operation encases the circumferential bands in an outer shell layer, either of poured or of gun-applied concrete. The other principal prestressing method, which has also been used successfully for tanks, is known commercially as the "preload system." In it the entire shell, including both vertical and horizontal rods, is poured in one operation, leaving the turnbuckles on the band steel unencased so that they can be turned up after the forms are removed. The secret of this method is to coat the encircling rods with a special asphaltic material so that they will not bond to the concrete.

So far in this country, work on prestressing other than tank concrete, such as beams and girders for example, has been confined to the laboratory, Prof. W. K. Hatt at Purdue having made an extensive series of tests about 1935. E. Freyssinnet in France was a leader in developing prestressing in Europe, and he as well as the Germans have some notable prestressed structures in service. One German bridge, for example, contains prestressed concrete girders of 108-ft. span.

While the basic advantage of prestressing is to eliminate tension cracking, it also offers opportunity, through a combination of high tensile steel, perhaps in the form of wire, and of high-strength concrete, to make members of high load capacity and of minimum section and weight. The stumbling block to its development has been the difficulty of devising practicable mechanical methods to effect the prestressing. The wider familiarity with prestressed concrete, which will result from the present concrete tank program, should, however, bring fresh minds to bear on this particular problem. The future of prestressed concrete is, therefore, worth watching with interest and anticipation.

Chicago's Filtration Project

SPECTACULAR IN SIZE and typifying in its function, structure and equipment the most advanced thinking in waterwork practice, Chicago's South District filtration project ranks as a notable engineering achievement. With a capacity of 320 million gallons a day, it is, of course, the world's largest water treatment plant. But its claims to distinction go far beyond this comparison; in large measure they rest on new contributions to the science of water purification.

For example, the experimental work prior to the design of the plant led to the development of a sodium silicate conditioning process. This aids in the "toughening" of coagulated matter, as a result of which it becomes possible to use smaller settling basins and permits higher filtration rates than are employed normally. Thus, use of the sodium silicate process not only produces a water of higher quality, but at Chicago served as a means to cut construction costs.

Again, in the design of the filters, a number of innovations have been introduced. These include: Provisions for high-rate operation; location of washwater gutters along one wall of the filter instead of in the center; use of deep tanks to prevent air-binding, and the methods adopted for surge control. In fact, almost every unit in the project reveals departures from standard practice, some of which are destined to have a profound influence of future developments in the field of water treatment plant design.

Waterworks engineers profitably can examine what has been done in Chicago. While few may be called upon to design a plant of this size, the fact is that there are scores of ideas in a project of this magnitude that readily may find adaptation elsewhere. It is with this thought that *Engineering News-Record* presents in this issue a special section devoted to the South District Filtration Project. Written entirely by staff engineers of the Chicago Division of Water Purification, this special section represents an outstanding contribution to the engineering literature on waterworks practice.

ENGINEERING NEWS-RECORD WALDO G. BOWMAN, *Editor*

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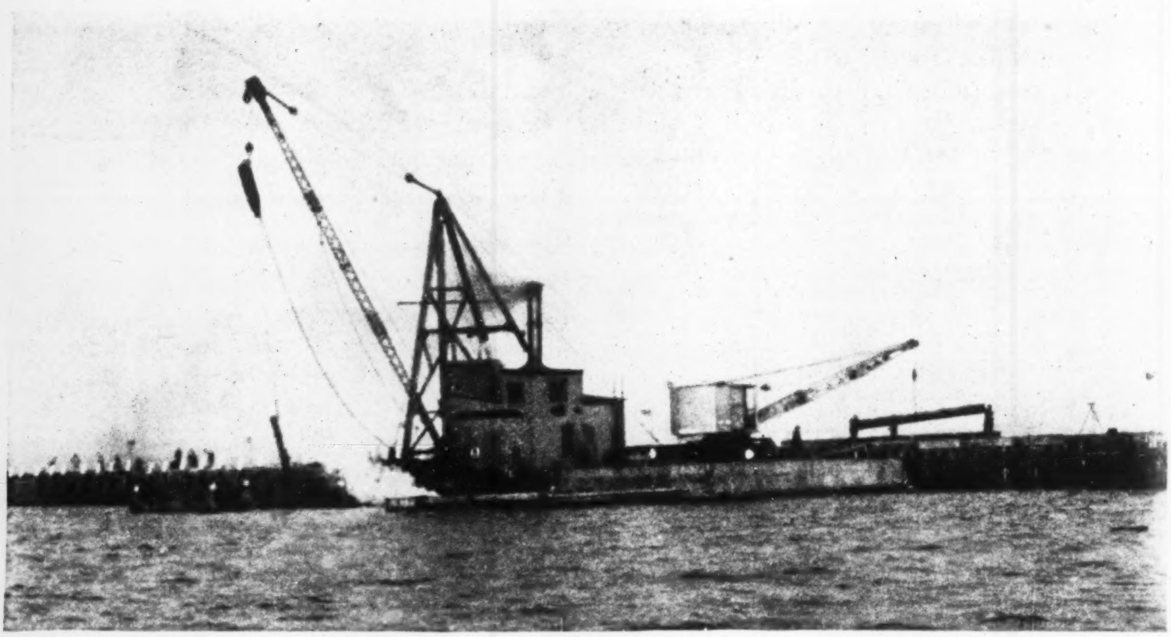


Fig. 1. Batter piles for pier are driven with the hammer in a special sling as crane on barge sets longitudinal stringers.

Laminated Decking Speeds Pier Construction

Contents in Brief—*Use of 3x6-in. timbers on edge, spiked together continuously across a 90-ft. wide dock over deep water, speeded construction by permitting the hauling of concrete and also saved steel by reducing the reinforcing in the concrete deck slab to a light mesh. The wood acted as an insulator to protect the bottom of the slab during winter construction. Wood fire stops with a special salt-water spray system and the concrete deck protect the pier and material on it from disastrous fires.*

DESIGNED TO SPEED ERECTION and protect deck concreting in winter a laminated timber sub-deck has been successfully used on a 90-ft. wide pier over deep water and a 41-ft. wide approach trestle, built for the Corps of Engineers, U. S. Army. The sub-deck permitted hauling during construction, and eliminated construction of forms at a place where spray in cold weather would have made the work slow and costly. This type of construction reduced the reinforcing from a bar pattern to a light mesh, laid with a minimum of labor, and at the same time provided a thick insulating blanket to protect the bottom of the slab in cold weather concreting.

Pier construction was done by floating equipment with most of the material coming to the job by water. Untreated timber piles, up to 90 ft. long, were driven in 25 pile bents, 10 ft. c.c., to form the 90-ft. wide pier that carries four lines of railroad track. In addition to the 25 piles, driven vertically, two piles on a 2 on 1 batter were used for lateral stability with a fender pile at 10 on 1 batter at each end of the bent. The 41-ft. wide approach trestle has 13 vertical piles per bent and a pile driven on a 3 on 1 batter at each end. The piles are shorter in the trestle section where the supporting ground is higher but all are driven to about 16-ton bearing by the *Engineering News* formula. The approach trestle has two lines of railroad tracks, spaced 27 ft. c.c. to permit a trucking roadway or clear passage for other use.

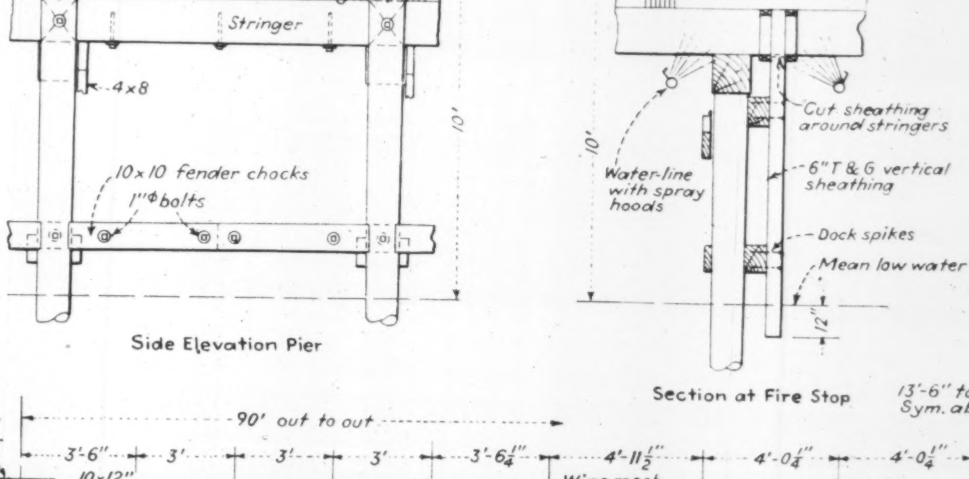
Below the deck the pier structure follows rather usual design practice with the vertical piles capped by a 14x14-in. untreated timber carrying 8x16 longitudinal stringers on a 10-ft. span. Three stringers are centered at each rail location with splices in the three pieces staggered and the ends butt spliced, each piece extending 7 in. on the pile cap. At other than rail locations a single 8x16-in. stringer, usually 32 ft. long, is lap spliced over the cap and the two stringers bolter together. At the line of batter piles 12x16-in. stringers are used, held to the cap by a 1¼-in. dia. bolt. The 12x16-in. stringers are also used along the exterior of the pier and are butt spliced with 4x16-in. by 4-ft. fish plates with four 1-in. dia. bolts.

Random length creosoted 3x6-in. timbers S1S1E (surfaced one side and one edge) are set on edge over the stringers. They are toenailed to each stringer with 40-d. nails and are held together with 40-d. nails about 12 in. c.c. alternately near the top and bottom of the piece. The S1S1E classification was selected to retain the greatest practical strength and value of the lumber without having it so rough that openings would be left where pieces are butt-spliced. The rough surface, and 60-d. nails driven at 2 ft. c.c. each way and left protruding 2 in. above the deck, provide bond with the concrete and give some of the effect of a composite beam, but this added value is not used in the design. Use of the 3x6-in. lumber on edge was found more economical and the material more readily obtainable than use of wide pieces of 6-in. thick lumber laid flat.

Spray protects wood fire stops

Much more than usual has been done on this structure to prevent and control the hazard of fire. A complete fire alarm system is in use with alarm boxes at frequent points along the full length of the pier and trestle. The concrete deck prevents the rapid spread of a fire below the deck to materials above, or vice versa. Untreated timber fire stops of 6-in. thick D & CM lumber are framed closely around the deck supporting structure and extend to about one foot below mean low water. They are located at 150-ft. intervals on the pier proper and 300 ft. apart on the narrower trestle. The fire stops, and the rest of the trestle, are protected by a pumped salt-water supply and a spray system designed to wet the fire walls. A large water-main extends the full length of the trestle, carried on the bents under the deck, and from this laterals extend to each side of the dock with a hose connection, kept below the curb level, at frequent intervals. At each side of the fire walls a branch from the salt-water line extends the full width of the structure and on it hooded spray nozzles are arranged to throw a blanketing spray of water on the fire walls. Water is not kept continuously in the line but is provided when required by pressure pumps located in a protected building at the shoreward end of the trestle. Not having water continuously in the line obviates the necessity for insulating the pipe against freezing. The salt-water fire protection system was dictated by the lack of both pressure and volume available in potable water supplies.

In addition to the salt-water line a main carrying potable water extends along the dock with frequent laterals to hose connection valves along each side of the dock. This water can be used for servicing of vessels and fire protection as required. Numerous openings about 10-in. dia. are provided through the deck, protected by a cast iron frame and cover, to admit a swivel nozzle used by the fire departments of the area in fighting dock fires. Manholes give access to


10'
2x12x1' blocks
Concrete deck slab
3x6 laminated decking
Stringer
4x8
10'
10x10 fender chocks
1"ϕ bolts
10'
Cut sheathing around stringers
6" T & G vertical sheathing
Water-line with spray hoods
Dock spikes
Mean low water
12"

Side Elevation Pier

Section at Fire Stop

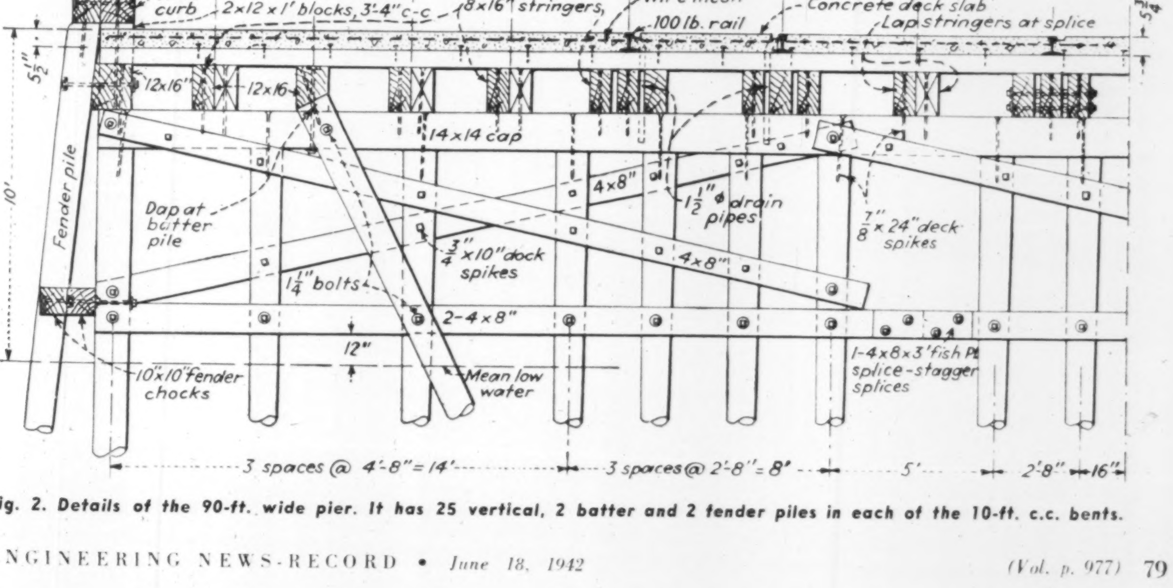

13'-6" to C.L. of pier Sym. about C.L.
10x10" fender cap
90' out to out
3'-6"
3'
3'
3'
3'-6¼"
4'-11½"
4'-0¼"
4'-0¼"
2'-5¾"
10x12" curb
2x12x1' blocks, 3'-4" c-c
8x16" stringers,
Wire mesh
100 lb. rail
Concrete deck slab
Lap stringers at splice
5¾"
5½"
12x16"
12x16
14x14 cap
10'
Fender pile
Dap at batter pile
4x8"
1½"ϕ drain pipes
⅞"x24" deck spikes
¾"x10" dock spikes
4x8"
1¼" bolts
2-4x8"
12"
10"x10" fender chocks
Mean low water
1-4x8x3' fish Pl. splice-stagger splices
3 spaces @ 4'-8" = 14'
3 spaces @ 2'-8" = 8'
5'
2'-8"
16"

Fig. 2. Details of the 90-ft. wide pier. It has 25 vertical, 2 batter and 2 fender piles in each of the 10-ft. c.c. bents.

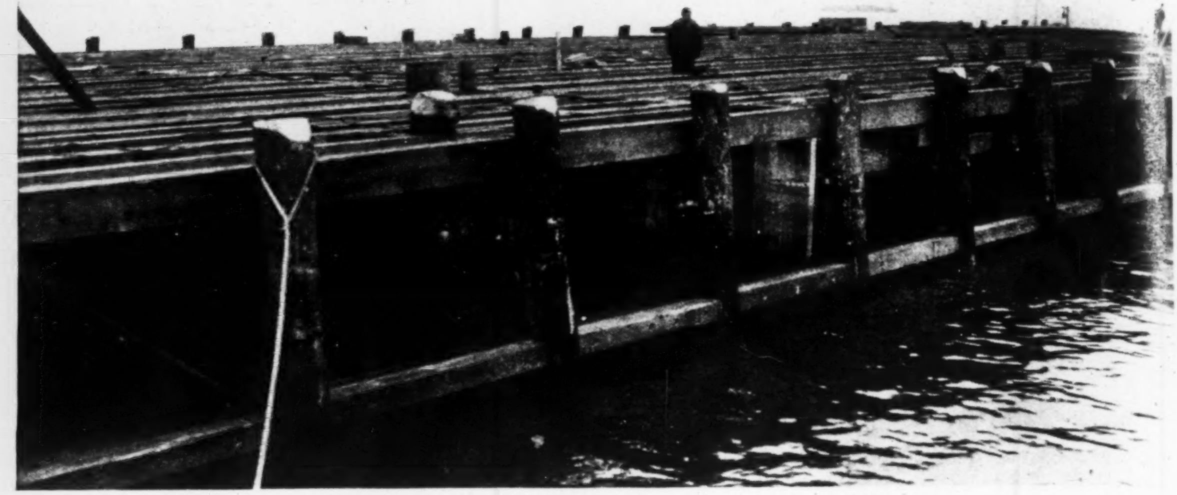


Fig. 3. Typical pier construction showing fender piles and timber fire stop that extends below the low-tide level.

below the deck so that fire-fighters can quickly get to a blaze.

Mooring-bitts are placed at intervals along both sides of the docks with special timber reinforcement between this area and the adjacent bents to stiffen the points of strain.

The piers are adequately lighted for night operation by batteries of eight floodlights each way on 60-ft. high poles set about 600 ft. apart. Concentric louvers direct the beams to give concentration of light on the pier and immediately around it yet prevent the glare from affecting shipping in the adjacent channels. Locating the lights on high towers makes general illumination of the pier area complete without shadows and is planned aid sabotage prevention.

Batter piles driven without leads

The vertical piles were installed with the usual floating drivers but the batter piles were driven by a floating derrick without the use of leads. The vertical piles in the bent were driven first so that a work platform could be established and then timber guides set for batter piles. A double-acting hammer was equipped with a sleeve to fit over a trimmed pile top and was placed in a specially rigged sling that held it to the batter of the pile as may be seen in Fig. 1. The pile butts were job trimmed to fit the sleeve on the hammer enabling the hammer to be held on the pile and assuring that it would follow to cut-off elevation without difficulty or delay. The sling around the hammer was adjusted for the different batters of the piles.

Pile driving and the considerable amount of hydraulic dredging necessary in the area was done on a 24-hour day, 7-day week basis. Most of the other work, including driving of the batter piles was found more satisfactory and economical on the daylight or two-shift basis only, especially as the construction was done largely in the winter months.

Most of the materials for timber construction came to the job by water. All the large timbers were swung into place by floating derricks or crawler cranes run on scows. Holes for the bolts and dock spikes were made with pneumatic equipment, those for the spikes being drilled $\frac{1}{16}$ in. smaller than the nominal diameter of the spike. Pneumatic hammers, with special sets, were used to drive the bolts and big spikes; pneumatic chain saws then made the pile cut-offs. All of the bracing for the dock is above low-tide level so it was placed by the usual method of working from timber floats or temporary planking spiked to the piles.

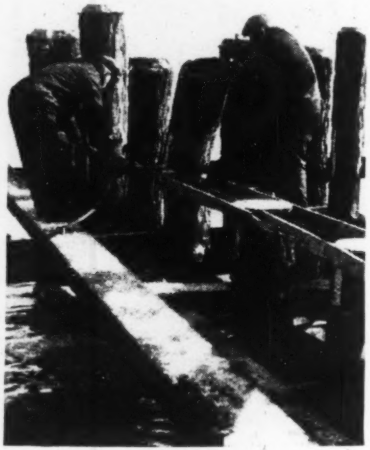


Fig. 5. A pneumatic chain saw makes the pile cut-offs.

The creosoted 3x6-in. material for the deck was laid on the stringers in crane loads, then distributed and nailed in edge position. No care was necessary to break joints over the stringers and no consideration was given to which edge of the S1S1E lumber was exposed permitting rapid laying of the deck. The S1S1E lumber and the method of construction left a rough surface that increased the bond of the concrete but also gave uneven support for the rail. Along the lines of the rail the rough edges of the timbers were adzed to a level line. The rails are held to the timber deck by special screw spikes, placed in sub-drilled holes with a pneumatic wrench. Bituminous paint was brushed on the rail sides to prevent bond with the concrete.

Timber sub-deck

Concrete for the $5\frac{1}{2}$ to $6\frac{1}{2}$-in. thick deck was placed directly on the wood surface in a single course, the mesh reinforcing being held at the proper level by chair supports. Strikeoff of the concrete was done by hand after some consolidation with a flexible shaft vibrator, used especially along the rail sides. Concrete was supplied by transit-mix trucks batched at a commercial plant on land and operating over the wood sub-decking or the previously placed concrete as convenient. This scheme of handling

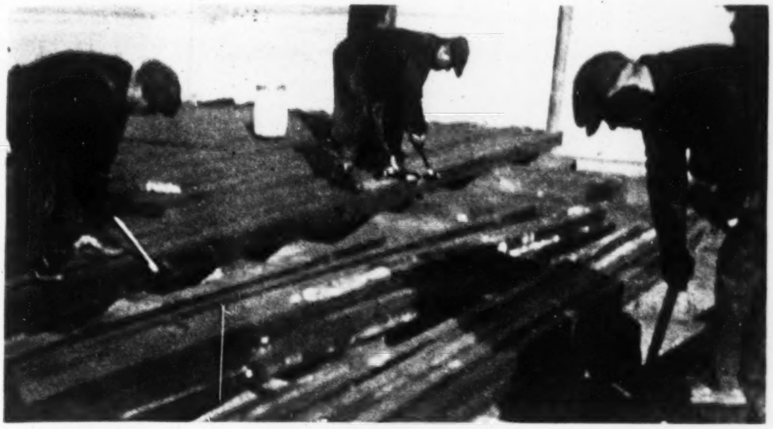


Fig. 4. *The 3x6-in. timber decking is toenailed to the stringers and then spiked to the adjacent pieces.*

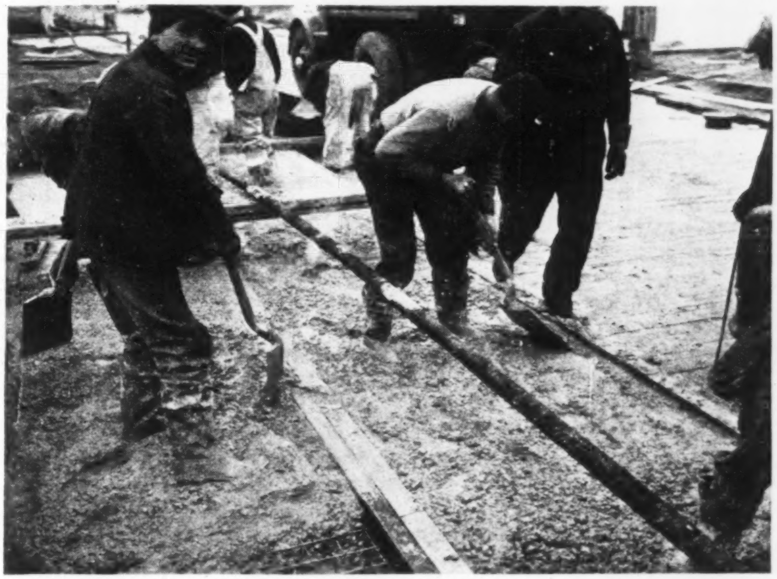


Fig. 6. *Six inches of concrete is placed over 3x6-in. timbers on edge, to provide a deck for the pier. In the winter the concrete is heated, the timbers protect the bottom of the slab and steam, through pipe in foreground, warms the top after covering with tarpaulin.*

eliminated the sometimes used floating mixer-plant with its high fixed charges and necessity for moving often several pieces of floating equipment required.

The use of the timber sub-deck eliminated the necessity for setting and stripping forms and made it possible to truck over the entire trestle and pier before the concrete was placed. The time saved was important as was decreased use of steel by elimination of bar reinforcing.

During cold weather the concrete, made with high-early strength cement, was placed on the deck at a temperature of about 70 deg. F. One or two steam lines were laid along the strip to be paved and about a foot above the finished concrete elevation. As soon as the concrete was struck off and finished it was given a spray coating of an asphalt emulsion to prevent rapid drying. Tarpaulins were placed over wood frames above steam pipes and heat was supplied from boilers on the floating equipment to prevent freezing. The 3x6-in. timber sub-deck served as an insulation blanket on the bottom of the slab to keep the heat in the concrete.

Information on the exact size of the project cannot be given at this time so that it is difficult to give an idea of the speed with which the job was constructed. However, despite winter weather and substantial additions to the project it was completed ahead of the original schedule.

The Frederick Snare Corporation were architect-engineers on the project and later became the builders under a negotiated contract agreement. L. E. Stephenson is assistant chief engineer and was in charge of this design. James Manning was superintendent on construction. E. C. Burr served as project engineer and Frank Taylor as field engineer.

Municipal "War Code" of Emergency Ordinances

All Ordinances passed to facilitate administration of the city government in time of war have been placed in a "war code" by Portland, Ore., according to the American Municipal Association. Any further ordinances of a war emergency nature will be placed in this code, most of which it is anticipated will be repealed after the war is over.

Articles in the code so far pertain to emergency police regulations like blackouts, adoption of "war time," rights and duties of city employees with reference to military service, emergency construction and plumbing standards, city purchasing of materials and supplies, housing and other provisions for civilian maintenance and explosives.

Except where penalties are specifically indicated, the fine for violating any portion of the "war code" is $500, or six months imprisonment or both.

In the blackout regulation, the city disclaims responsibility for damage or loss to person or property suffered as a result of any blackout authorized by city, state or U. S. authorities. The emergency construction and plumbing provisions permit substitution for building materials essential to the prosecution of the war.

Under the purchasing article of the code, the city purchasing agent is authorized to buy articles and materials up to $250 in value without advertising for bids. Another section puts the inventory supervisor of the city in charge of civilian defense supplies and equipment.

Compilation of the "war code" was a project of the Bureau of Municipal Research and Service and the League of Oregon Cities, with assistance of the Work Projects Administration.

Keeping Debris Out of Reservoirs By Soil Erosion Control

Several years experience has been accumulated in soil erosion control on the watersheds of the East Bay Municipal Utility District in California. The program was introduced by the district to prevent further erosion damage to watersheds and to put a stop to the considerable flow of eroded material that annually was carried down into reservoirs, decreasing their capacity. Sediment brought down by small tributaries and gullies had been causing heavy bank erosion on the main channels above the district's storage reservoirs.

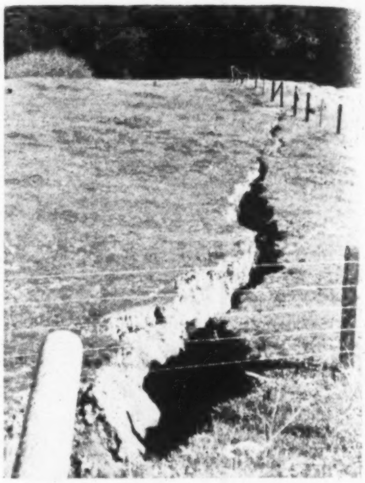
In 1938 the district started reservoir silting studies and early in 1940 made a working agreement with the U. S. Soil Conservation Service and arranged for the use of WPA crews. Extensive surveys were made in the several principal watersheds to obtain detailed information on vegetation cover, location of areas where particular attention to erosion control was needed, and the particular kind of improvements that would accomplish the desired results most effectively. Reduction of the quantities of sediment annually carried into San Pablo and other reservoirs was a primary consideration.

The protective work undertaken included specially designed non-clogging inlets and protective aprons to prevent erosion at the discharge end of 30 culverts under roads; stream bank protection; tree planting; interceptor ditches and flumes around road cuts and areas subjected to slides; and the construction of check dams of different types to reduce the stream gradient of creeks and gullies.

Where the height was not great, the check dams were made of rubble masonry. Elsewhere earth fills were constructed of the sort known as "Missouri type" dams in which the spillway consists of a metal pipe culvert whose upstream end terminates in a riser or vertical section that functions as a circular spillway. If and when sediment collects in the storage basin up to the level of the circular spillway lip, additional lengths of pipe are added. The spillway crest is provided with a trash rack having vanes to prevent the formation of a vortex and to keep out débris.

Excellent success has attended the construction of these protective works and a great improvement has been made in erosion conditions.

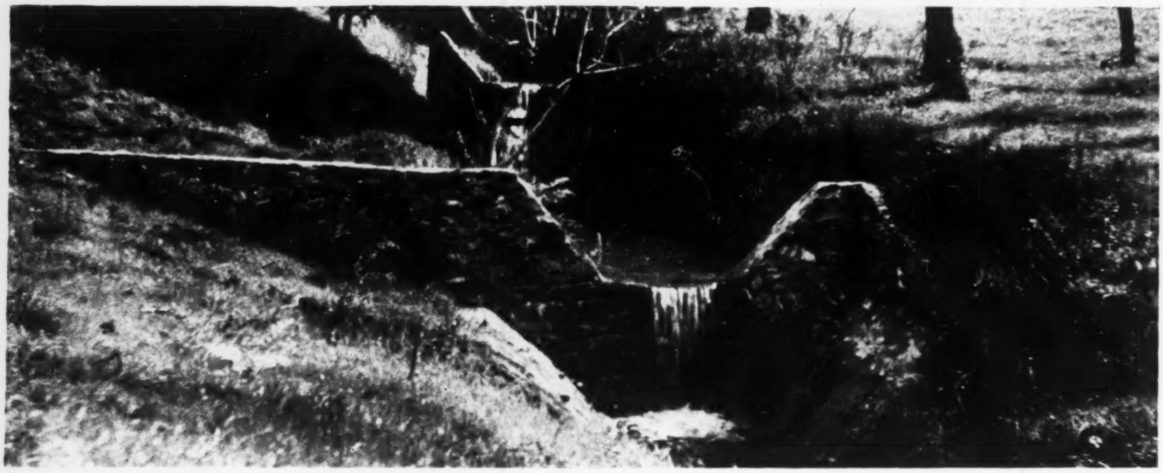
The district's experience with some 45 check dams, large and small, has afforded unusual opportunity to observe the grades which the silt deposits finally take after the ponds eventually fill with detritus. Although these observations are still continuing, thus far the conclusion is that the grades will vary inversely with the size of the drainage area. The maximum size of the material carried by the creek naturally affects the grade as coarser material takes a steeper slope. On the small drainage areas (say 100 to 600 acres) the silt grade was found to vary between 1.3 and 2.3 percent. On the larger areas (from 1,000 to 8,000 acres) it ranged from 0.25 to 1 percent.



Road culvert, discharging several feet above ground surface, erodes the slope below; several hundred cubic yards of sediment were removed in one instance!

Except in cases where exceptionally heavy volumes of débris were carried down (such as resulted from slides or erosion below projecting road culverts) the rate of silt deposition usually was such as would require several years to fill the débris basins. It has been noted that these gradual accretions affect the gradient of the streambed above the actual reservoir area; thus the amount of débris ultimately stored may exceed the reservoir capacity.

The soil conservation work has been done under the direction of J. S. Longwell, chief engineer and general manager, East Bay Municipal Utility District.



Small masonry check dams have stabilized the grade and encouraged protective growth in creeks and gullies. An 81 sec.-ft. flood passed over the dams here shown. Earth dams with pipe spillways also are used.

Concrete Frames Designed to Save Steel

Jaro J. Polivka
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Berkeley, Calif.

***Contents in Brief**—A considerable saving of steel in reinforced-concrete structures can be attained through careful design and accurate analysis, based on experience and laboratory tests. Still greater reductions are possible by using light-weight fillers for one and two-way slabs. For one-way slab designs steel savings up to 47 percent are possible when compared with conventional designs, and with the two-way construction a decrease of 56 percent may be obtained. Sample calculations are made available to show that the use of the fillers need not materially increase the total costs.*

THE BUSY DESIGNER has little time or inclination to devote much effort to accurate analysis and investigations of the most economical type of design. More or less approximate methods of analysis and shortcuts are preferred, especially with more complicated structures. However, the present emergency and current steel shortage open new possibilities to experienced engineers and designers in selecting designs that provide the greatest possible economy of critical materials.

In reinforced-concrete structures the simple process of increasing the lever arm of the interior forces—which may be accomplished by greater slab thickness and through an increase in the depth of beams and girders—assures considerable steel economy. This was clearly demonstrated by Arthur H. Brewer in his valuable article, "Designing to Save Steel" (*ENR* Nov. 6, 1941, p. 669).

Here it was shown that a 25 percent steel saving can be attained by several simple changes. These included: Adopting slabs 1 in. thicker than required by analysis; making the beams and girders 20 to 40 percent deeper; using a one percent minimum reinforcement of the columns; putting the footing reinforcement on a 0.2 percent basis; and using a higher ultimate-strength concrete, such as a 3,000-lb., instead of a 2,000-lb. concrete.

However, Mr. Brewer's method has its limitations, since the increased lever arm of the interior forces may cause increased dead loads for the floor and roof structures. This, of course, affects the dead load of the supporting structural members, including the columns and foundations.

In this article steel savings in excess of the figures presented by Mr. Brewer will be discussed. It will also be demonstrated that savings in steel are not necessarily accompanied by an increase in total costs of the structures.

Light-weight slab fillers

The disadvantage of a higher dead load due to the increase in thickness of a solid slab can be eliminated by light-weight fillers, which are available throughout the country. The fillers include: common brick, clay tile, plain or hollow blocks of pumice concrete, and cinder or slag concrete. The most suitable filler is chosen in accordance with its availability and in relation to the necessary reduction of dead load in any particular design. The average weight of some common fillers as compared with the average weight of reinforced concrete is shown in Table 1.

The fillers listed in Table 1 cost

TABLE 1. WEIGHT OF FILLERS

(lb. per sq. ft. per in. of thickness)

Material	Weight
Reinforced concrete (ave.)	12½
Plain concrete	12
Hollow blocks of plain concrete	7
Haydite concrete	9
Cinder, slag, pumice, concrete	
a) Plain	6
b) Hollow blocks	4½
Clay tile	4

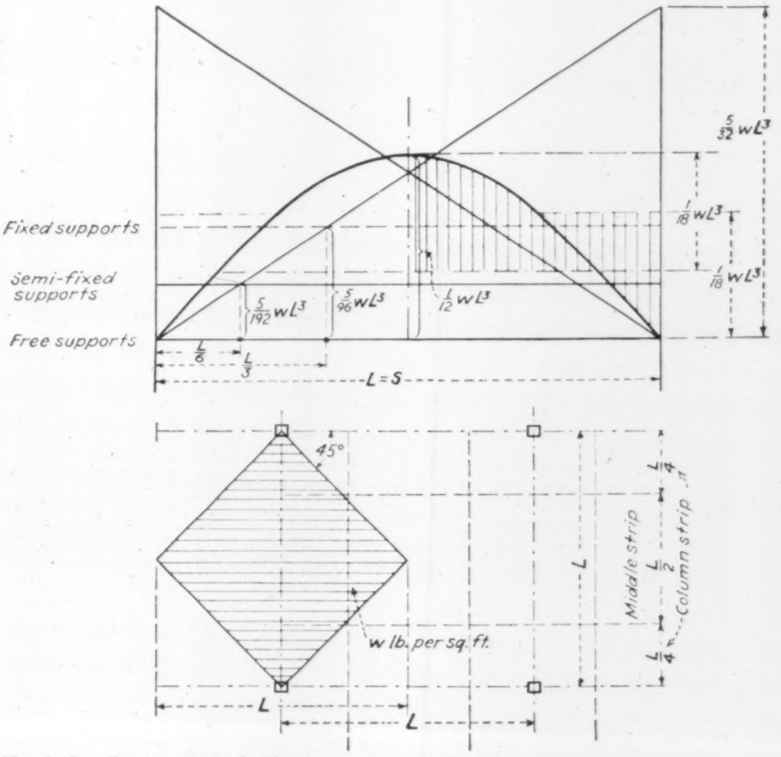


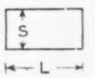
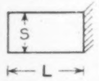
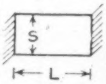
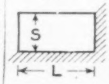
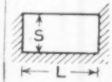
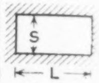
Fig. 1. Bending moments in the beams due to the loads from the two-way slabs for different methods of joining the slabs to the supporting beams.

TABLE 2. BENDING MOMENT COEFFICIENTS FOR TWO-WAY SLABS*

This table is for $m = \frac{S}{L} = \frac{\text{short span}}{\text{long span}}$. The maximum bending moments in the mi

strips are: $+M_S = \frac{1}{c_S}wS^2$, and $-M_L = \frac{1}{c_L}wL^2$. The maximum bending moments in

column strips are: $+M_S = \frac{1}{2c_S}wS^2$ and $-M_L = \frac{1}{2c_L}wL^2$.

	Type a		Type b		Type c		Type d		Type e		Type f	
												
$m = \frac{S}{L}$	c_L	c_S	c_L	c_S	c_L	c_S	c_L	c_S	c_L	c_S	c_L	c_S
0.50	169	11	141	11	136	12	272	17	246	18	437	27
0.60	95	12	85	14	88	16	146	19	139	21	229	30
0.70	62	15	59	17	64	22	90	22	91	25	139	33
0.80	44	18	45	22	59	39	62	26	66	31	95	39
0.90	34	22	36	28	42	41	47	31	53	40	70	46
1.00	27	27	39	37	37	56	37	37	44	51	56	56
1.20	19	40	23	61	32	102	27	56	35	84	41	85
1.40	15	58	20	100	29	176	22	85	31	138	34	131
1.60	13	84	18	159	28	288	19	128	29	219	31	200
1.80	11	122	17	240	27	451	18	188	27	336	29	299
2.00	11	169	16	357	26	676	17	272	27	498	27	437

* POLIVKA: "Le Beton Translucide," Bruxelles, 1934, p. 119.

TABLE 3. MATERIALS NEEDED FOR DESIGNS I, II AND III

Items	Frame I		Frame II		Frame III	
Reinforcing steel	lb.	cost	lb.	cost	lb.	cost
Slab	0.650	$0.039	1.320	$0.079	1.525	$0.092
Beam (girder)	1.532	0.069	0.682	0.041	0.682	0.031
Column, vert	0.525	0.024	0.525	0.024	0.525	0.024
Column, spirals	0.260	0.016	0.269	0.016	0.269	0.016
Footings	0.262	0.012	0.262	0.012	0.262	0.012
Totals	3.229	$0.160	3.019	$0.162	3.254	$0.175
Concrete (incl. filler)	cu. ft.	cost	cu. ft.	cost	cu. ft.	cost
Slab, beam	0.822	——	0.819	——	0.651	——
Column	0.073	——	0.073	——	0.073	——
Footings	0.147	——	0.147	——	0.147	——
Totals	1.042	$0.385	1.039	$0.385	0.871	$0.322
Forms	sq. ft.	cost	sq. ft.	cost	sq. ft.	cost
Slab (overall)	1.000	——	1.000	——	1.000	——
Beam (girder)	0.568	——	0.595	——	0.595	——
Column	0.160	——	0.160	——	0.169	——
Footing	0.050	——	0.059	——	0.059	——
Totals	1.778	$0.356	1.715	$0.343	1.715	$0.343
Hand excavation	cu. ft.	cost	cu. ft.	cost	cu. ft.	cost
Totals	0.017	$0.009	0.017	$0.009	0.017	$0.009
Grand total, sq. ft. cost		$0.910		$0.899		$0.849

Note: The unit quantities and costs are averages per square foot of framed floor area. The assumed unit costs are: reinforcing steel in place as slab bars and column spirals, $6.00 per cwt., other bars, $4.50 per cwt.; concrete of 3,000-lb. strength in place, 37 c. per cu. ft.; forms, 20 c. per sq. ft., and hand excavation, 5 c. per cu. ft.

from 32c. to 38c. per cu.ft. in place, or very close to that of concrete, which is about 35c. and 37c. per cu.ft. for 2,000 and 3,000-lb. concrete, respectively. Thus, the comparative costs easily can be established. The big advantage in using fillers is that they can be combined with a more economical design of slabs due to their monolithic character and two-way continuity.

Values of the bending moment coefficient (c) for the middle strips for both short and long spans of two-way rectangular slabs supported on four sides are given in Table 2. The conditions are for varying ratios of the short and long spans $\left(m = \frac{S}{L}\right)$. The coefficients $\frac{1}{c_s}$ and $\frac{1}{c_L}$, when multiplied by wS^2 and wL^2, give the maximum bending moments per unit width for isolated panels with one or more edges rigidly restrained. The moment coefficients for slabs continuous in both directions are calculated from the values of Table 2 with appropriate modifications regarding the continuity. The modifications are given in Table 5 of the Joint Committee's *Recommended Practice and Standard Specifications for Concrete and Reinforced Concrete*, June 1940. (See also *Standards of Design for Concrete*, U. S. Navy Department, Section 7.)

The bending moments in the supporting girders are obtained by the methods of mechanics appropriate to the conditions of support. It is assumed that the loads are uniformly distributed within the tributary areas of the panel bounded by the intersection of 45-deg. lines from the corners with the median line of the panel parallel to the long side (see Para. 815, *Recommended Practice and Standard Specifications for Concrete and Reinforced Concrete*). How to make such a computation is demonstrated by Examples II and III.

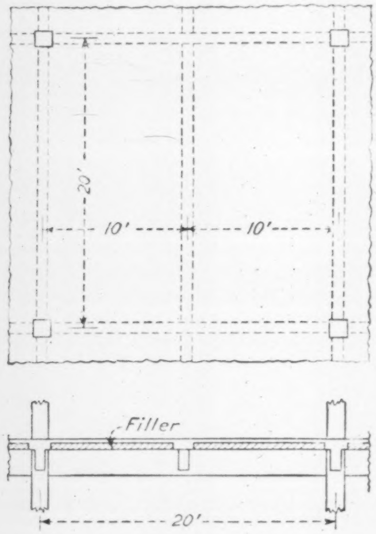


Fig. 2. Ribbed, one-way slab of 10-ft. span. A 5-in. thick filler of hollow, two-cell 5x8x12-in. blocks of lightweight material and a 2-in. top cover makes the slab's total thickness 7 in. This design is referred to as Example I.

The effect on steel saving is demonstrated on a typical interior framed area. The slab is designed for a live load of 100 lb. per sq.ft. and supported by columns 20 ft. apart in both directions, in accordance with American Concrete Institute building code of 1936 and the Joint Committee specifications of June 1940.

Example I—Assume first a ribbed, one-way slab with filler and of 10-ft. span, as shown in Fig. 2. In order to secure the dead-load strength of a 5-in. solid slab a 5-in. thick filler is

TABLE 4. COMPARSON OF TOTAL STEEL DEMANDS AND COSTS

Scheme number	I	II	III	1*	2*	3*	4*	5*
Reinf. steel, lb. sq. ft.	3.229	3.049	3.254	4.162	4.696	4.214	4.750	3.704
Total costs per sq. ft.	0.910	0.899	0.849	0.885	0.861	0.826	0.827	0.873
Using Scheme I								
Reinf., plus, $	—		0.035	0.933	1.467	0.985	1.521	0.475
plus, %	—		1	28	45	30	47	14
minus, $	—	0.180						
minus, %	—	5						
Total costs, minus, $		0.011	0.061	0.025	0.019	0.084	0.083	0.037
minus, %		1	6	3	2	[illegible]	9	4
Using Scheme II								
Reinf., plus, $	0.180		0.205	1.113	1.647	1.165	1.701	0.655
plus, %	5		6	37	54	38	56	21
Total costs, plus, $	0.011							
plus, %	1	—						
minus, $			0.050	0.014	0.008	0.073	0.072	0.026
minus, %			5	1	1	8	8	2
Using Scheme III								
Reinf., plus, $				0.908	0.442	0.860	1.496	0.450
plus, %				28	44	29	46	13
minus, $	0.035	0.205						
minus, %	1	6						
Total costs, plus, $	0.061	0.050		0.036	0.042			0.024
plus, %	7	5		3	4			2
minus, $						0.023	0.022	
minus, %						2	2	
Using Scheme 1								
Reinf., plus, $					0.534	0.052	0.588	
plus, %					12	1	14	
minus, $	0.933	1.113	0.908					0.458
minus, %	22	26	22					11
Total costs, plus, $	0.025	0.014			0.006			
plus, %	2	1			1			
minus, $			0.036			0.059	0.058	0.012
minus, %	—		4	—	—	6	6	1
Using Scheme 2								
Reinf., plus, $							0.054	
plus, %							1	
minus, $	1.467	1.647	1.442	0.534	—	0.482		0.992
minus, %	21	34	31	11	—	10		21
Total costs, plus, $	0.019	0.008						
plus, %	2	1						
minus, $			0.042	0.006		0.065	0.064	0.014
minus, %			4	1		7	7	1
Using Scheme 5								
Reinf., plus, $				0.458	0.992	0.510	1.046	—
plus, %				12	27	14	28	—
minus, $	9.475	0.655	0.450					—
minus, %	12	17	12					—
Total costs, plus, $	0.027	0.026		0.012	0.108			—
plus, %	3	3		1	2			—
minus, $	—	—	0.024	—		0.047	0.046	—
minus, %	—	—	2	—	—	5	5	—

* Schemes 1, 2, 3, 4 and 5 are in accordance with Brewer's method.

used. The filler consists of hollow, two-cell, 5x8x12-in. blocks of lightweight material with a 2-in. concrete slab over the filler, making the slab's total thickness 7 in. The slab, beams and girders are designed for the clear spans and on the basis of positive and negative moments of $\frac{1}{12}wL^2$. The joints, 3 in. wide, are reinforced with one ⅜-in. round bar, either straight or with bent adequate overlap at the supporting beams. The 2-in. top slab is reinforced with ¼-in. round shrinkage bars on 12-in. centers.

The beam, 7½x26 in., is reinforced with one 1-in. round straight bar and one 1-in. round bent bar, and with twelve ⅜-in. round stirrups. The girder, 9½x28 in., is reinforced with three 1-in. round bars, one straight and two bent, and nineteen ⅜-in. round stirrups. The average unit quantities and costs of the steel, concrete and forms are given in Table 3. Example I was prepared in accordance with the methods outlined in Mr. Brewer's article.

Example II—For this example a ribbed, two-way slab with a filler is used in a 20x20-ft. panel, as shown in Fig. 3. Eliminating the intermediate beams, the total thickness of the slab shown in Fig. 3 can be increased to 7½ in. without affecting the dead load. The 5-in. thick filler is used again plus a 2½-in. top slab. The total depth satisfies the recommended thickness given by the formula (Para. 814 RP):

$$t = \left(S + \frac{S}{m} - \frac{S}{10}\right)\left(\frac{1}{72}\right)\sqrt{\frac{2{,}500}{f'_c}} =$$

5 in., which is less than the 7½ in. depth available.

For the slab the maximum positive moment at midspan is $+M_{max} = \frac{1}{10} wL^2$; and the maximum moment is $-M_{max} = \frac{1}{30} wL^2$. Referring to Fig. 1, the maximum bending moments in the beams, due to the total load transmitted by the slab, are as follows:

Type of Support	Max. Positive	Max. Negative
Free	$\frac{1}{12} wL^2$	0
Fixed	$\frac{1}{32} wL^2$	$5/96\, wL^2$
Semi-rigid	$\frac{11}{192} wL^2$	$5/192\, wL^2$

The girders are designed on the basis of positive and negative moments equal to $\frac{1}{18} wL^2$ and increased by the moments $\frac{1}{12} w_b L^2$ due to the dead load of the beam, which is referred to as w_b per ft. The required

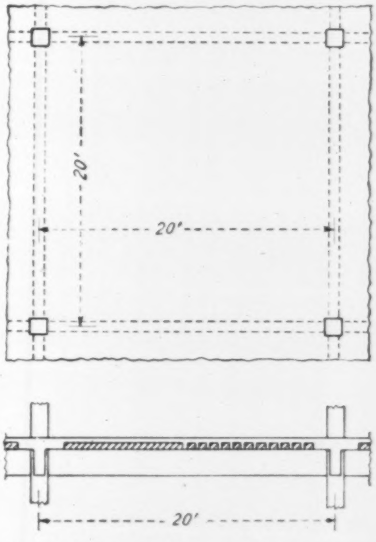


Fig. 3. Ribbed, two-way slab referred to in Example II. The filler is 5 in. thick and of the same construction as for the slab in Fig. 2. However a 2½-in. thick top cover makes the total thickness 7½ in.

reinforcement is two $\frac{3}{4}$-in. round, straight bars and two $\frac{3}{8}$-in. round, bent bars, plus nineteen $\frac{3}{8}$-in. round stirrups. The unit quantities and costs are given in Table 3.

Example III—Finally a solid, two-way slab in a 20x20-ft. panel is studied for the same dead load as in previous examples. The thickness of the slab is $5\frac{1}{2}$ in. The required reinforcements is $\frac{3}{8}$-in. round bars both ways, alternately straight and bent with 5-in. and 10-in. spacings in the middle and column strips, respectively. The beams are as for Example II. The unit quantities and the costs are listed in Table 3.

Conclusions as to steel savings

Comparison of the total steel demands and costs for Examples I, II and III as compared to Schemes 1, 2, 3, 4 and 5 of Mr. Brewer's article are given in Table 4.

On the basis of the comparisons afforded by the table just mentioned two conclusions may be no as to the economical characteristi of the proposed designs. These ar (1) by using fillers, which cause great increase in the dead load, ste savings up to 47 percent are possibl with one-way slabs with intermediat beams, and up to 56 percent wit two-way slabs; and (2) using tw way slabs without a filler the stee savings may be as high as 46 percent and at only slight variation in th total costs.

Stone Arch Falls Under Modern Traffic

ONE of the oldest stone arch bridges in the United States—built in 1809, near Frederick, Md.—collapsed recently to end an unequal struggle with continually increasing motor traffic.

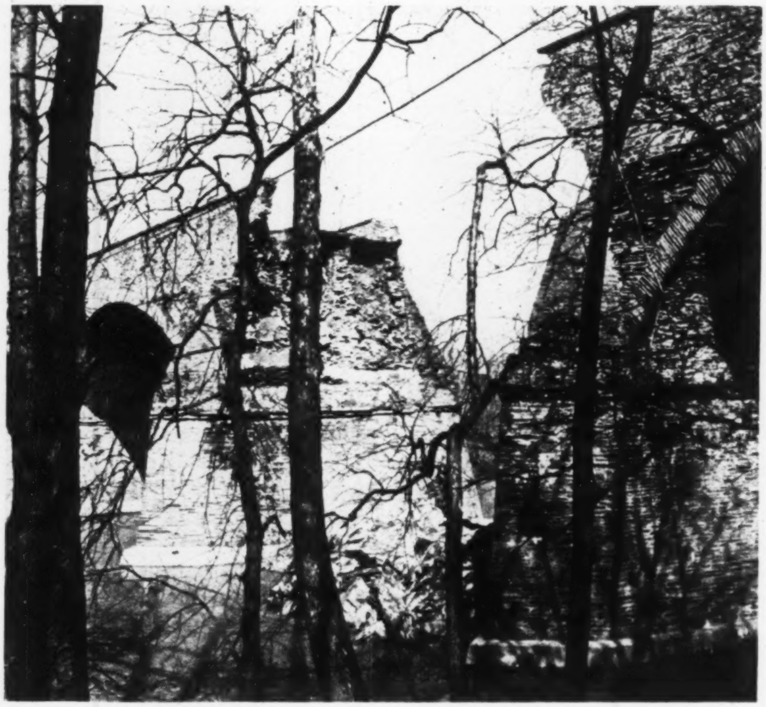
Known familiarly as the "Old Jug" bridge, the structure consisted of four arch spans with 70-ft. clear openings. Longitudinal masonry walls were built on top of the stone arch barrels to form three long cellular spaces into which spandrel fills were placed. The outside spandrel walls were carried up to a sufficient height to form a stone parapet, and the roadway, which at first was either an earth or water-bound road, was eventually paved with asphaltic macadam.

Wilson T. Ballard, chief engineer of the State Roads Commission of Maryland, said he became apprehensive as to the behavior of the structure more than two years ago, and at that time established points in the faces of the arch barrels for period checks of any settlement. The conformation of the first and third arch spans from the west or Frederick end of the bridge made it appear that the original builders did not use sufficient care in keeping the arch centers wedged up, Mr. Ballard said, and as a result the easterly quarters of the arch on these barrels appeared to sag somewhat below true arch lines. Late in 1941, a movement of as much as 2 in. on the upstream side of the third span arch barrel, and 4 in. on the downstream side of the same arch became apparent and caused a rupture in the upstream parapet wall over the quarter point of the arch span. In February, 1942, the bridge was posted for 6,000-lb. loads and truck traffic was prohibited.

On the afternoon of March 3, 1942, shortly after a highway department representative inspected the bridge and recommended that it be closed, a section about 30 ft. long broke out of the east quarter of the third span from the Frederick end and fell into the river. The accompanying photo shows this span after the remainder of the arch had fallen into the river.

W. C. Hopkins, bridge engineer for the commission, said that the failure probably was caused by the poor conformation of the first and third arches from the west end which placed the pressure lines well outside the arch barrels. The fact that the bridge was built long before the days of present large volume traffic and heavy axle loads is also significant. The failure apparently was delayed to some extent because the earth spandrel fills became compacted to such an extent that they acted in part as arch ribs and assisted the masonry to carry the load. The final failure occurred after several days of heavy rain, which may have seeped into the fills.

A new bridge, a short way downstream from the "Jug" bridge, and a relocation of Route 40, which leads to the old structure, are already planned and will be started during the present year. In the meantime, however, studies are being made with a view to placing a temporary structure across the river near the old bridge.



Initial break in 133-year old "Jug Bridge" occurred in the center of this arch

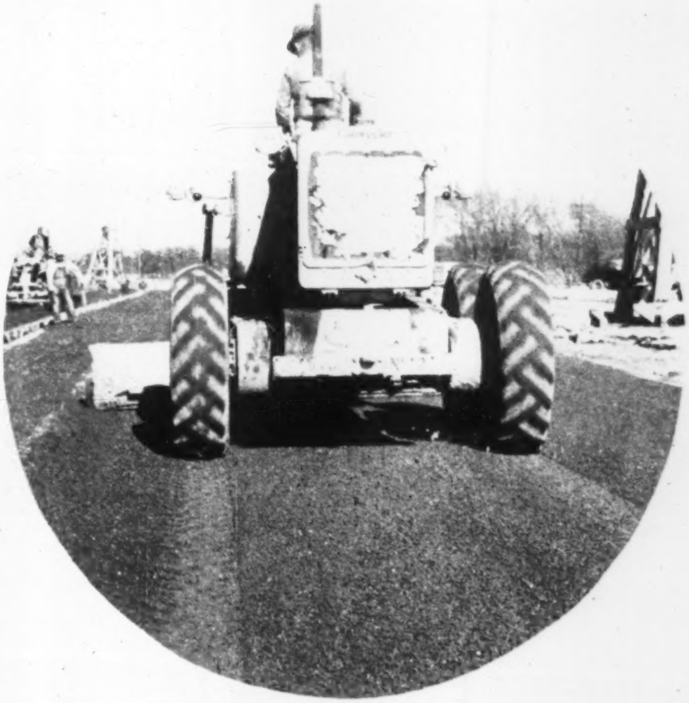


Fig. 1. A patrol grader is used to remove the excess material from a lane of "chat cement" pavement as the job nears completion.

New Type Pavement from Mine Tailings

***Contents in Brief**—Now being built by the Tulsa District, U. S. Engineers, is a new type of low-cost pavement in which tailings from zinc and lead mines are added to the soil and cement mixtures commonly used in soil-cement roads. Advantages and limitations of the pavement are pointed out, and satisfactory methods of construction are described. Various experiments with different sub-bases are also outlined.*

A NEW TYPE of pavement combining the use of lead and zinc mine waste (known as "chats") with small quantities of portland cement and silty soil is now being constructed by the U. S. Army Engineers in the Tulsa, Okla., district. Advantages of the pavement, which is expected to be of low cost once certain construction kinks have been eliminated, are: (1) its relative cheapness compared with plain or reinforced concrete; (2) use of materials that can be mixed in place; (3) its suitability in places where soil-cement pavements are unsatisfactory; (4) installation with no more equipment than that normally employed for soil-cement work, with much less heavy equipment needed than for concrete paving; and (5) elimination of the need for expansion joints and steel reinforcing.

The waste material used is a gray, crushed siliceous limestone with the maximum size $\frac{3}{8}$-in. dia. It is available in almost unlimited quantities as tailings at zinc and lead mines in Oklahoma, Missouri, and Kansas, and in the past has been used principally for railroad track ballast. Material being used in the Tulsa district is purchased at 25c. per ton from mines near Picher, Okla., and transportation to the site costs 88c. per ton.

On one project about 285,000 sq. yd. of 6-in. pavement are being laid to provide parking space for automobiles. In this operation the chats are combined with 12 percent by volume of ordinary portland cement and 5 to 15 percent of black silty soil classified as A-4 type under standards of the Public Roads Administration. An A-4 soil is a silty material containing less than 55 percent of sand by dry weight, a material free of appreciable amounts of clay, and a soil having a tendency to absorb moisture rapidly and to lose stability when wet. The purpose of adding the A-4 soil to the paving mixture is to speed setting, to obtain a more densely graded aggregate and to add workability.

Construction steps followed

Construction of the "chat-cement" pavement, as it has been designated, in many ways is similar to that of the soil-cement pavements. On the parking project the sub-soil beneath the paved area consisted of a "fat" clay considered unstable, and this led to the decision to blanket the site with 10 in. of A-4 soil, available on the job as topsoil. The pavement subgrade was then prepared by blading and rolling with sheepsfoot rollers. Excess topsoil of type A-4 was placed in nearby stock piles during the subgrading operations for future use in building the pavement.

Side forms of 6x6-in. timbers were used to permit construction of alternate 25-ft. wide lanes, a method that eliminated the use of forms for the last lanes paved. Restricting the sec-

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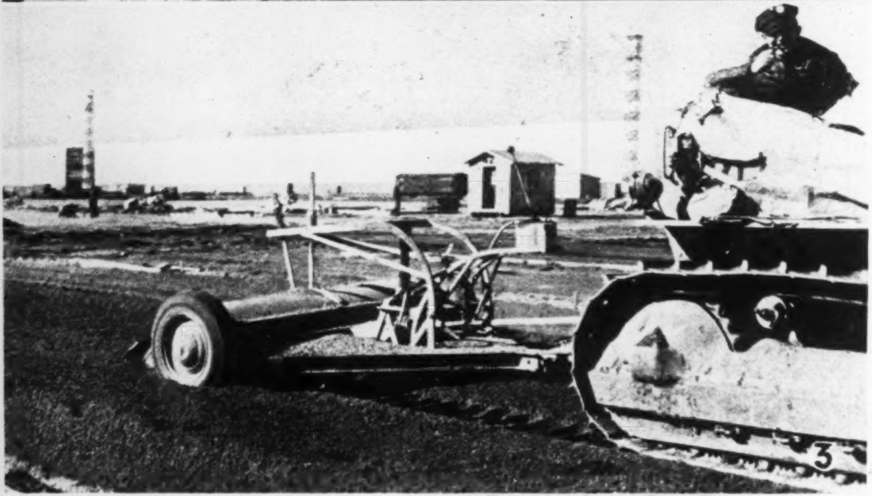
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tion under construction to a length of 500 to 1,000 ft. has proven satisfactory.

With the side forms in place, the chats and topsoil were then distributed in the proper proportions as required to make a 6-in. compacted thickness. Distribution was by dump trucks traveling between the forms; after a little practice the truck drivers were able to spread the material to the desired thickness by driving slowly during dumping. The material was then leveled to a uniform grade by blading.

Cement in bags was next added, workmen spotting by hand the bags as they were unloaded from a truck traveling between the forms. The usual requirement was 0.54 bags per sq.yd., and the common practice was to place the sacks in five rows across the lane with the spacing determined by a chain marked at the proper intervals. After the cement was spread by hand, the dry mixing of the materials followed as soon as possible. This was one of the most important operations and usually required from one and one-half to three hours; gang plows and rotary tillers were used. After a little experience the proper mix could be readily determined by visual inspection. Hence this determination was pretty much in the nature of a field test.

Low moisture content

Moisture content of the paving mix, which was probably 5 percent at the start, was increased to about 9 percent, depending upon the mix required. Pressure distributors of 900-gal. capacity were used to add the water, and several applications were found preferable to a single trip. Mixing of the materials with the plows and tillers continued as the water was added. The pavement was usually ready for rolling about two hours after the first application.

The most successful plan was to

Figs. 2-5. Cement is supplied in bags and spread by hand; cement content is from 5 to 15 percent by dry weight. After cement is spread the materials are mixed by rotary tillers (Fig. 3) and next by gang plows (Fig. 4). A sheepsfoot roller and a spring tooth harrow then operate in succession (Fig. 5). The roller is for compaction and the harrow to aid the mixing and to prevent the roller from "walking out" too fast.

compact the slab by several passes of the sheepsfoot rollers, usually five or six, with each of the first few rollings followed by the passage of a spring-tooth harrow stirring to less depth each time. When the sheepsfoot rollers began to "walk out" the harrow was not used; instead the slab was struck off with one or two passages of a nail drag to remove the surface irregularities. Blading also started during the last passage of the sheepsfoot rollers. Generally, each trip of the drag was followed by two trips with a pneumatic roller. Final compaction was by a 10-ton tandem smooth roller, and but one or two passages of this equipment was required. Hand tamping was necessary along the edge of the slab next to forms.

Pavement is slow setting

Covering the slab for seven days with waterproof paper was necessary to prevent moisture loss. The paper keeps sufficient moisture in the slab for complete hydration without water being added but it is necessary that a tough, fibrous paper be used to stand the wind and abuse encountered in the field. The pavement was slow-setting, attaining an average compressive strength of 1,400 psi. at 7 days and 2,200 psi. at 28 days. The density of the finished slab averaged about 135 lb. per cu.ft.

It is expected that after a seasoning period, some form of bituminous material will need to be added to the parking area for a wearing surface and to check surface disintegration. Such a covering was used at one municipal airport in the Tulsa district where a similar pavement was employed for the runways. This was done to keep the airplane propellers from picking up dust on the surface of this area.

As mentioned previously, no expansion joints were used for the parking area. However, no serious cracking has occurred, although small transverse cracks have developed at

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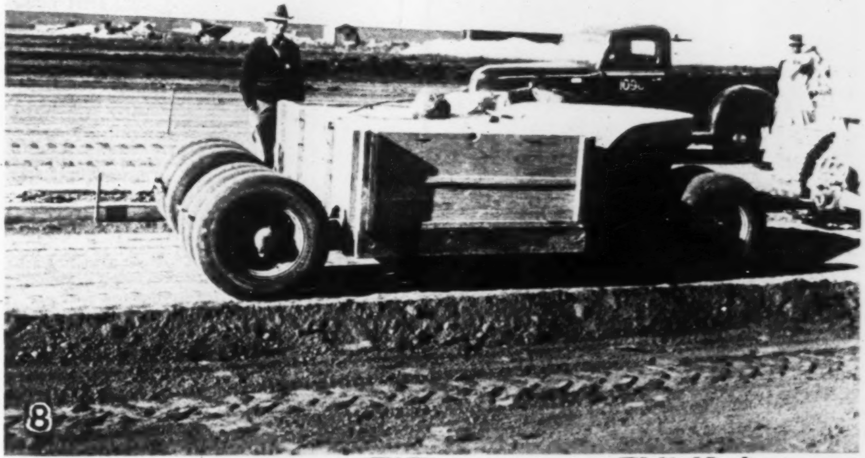

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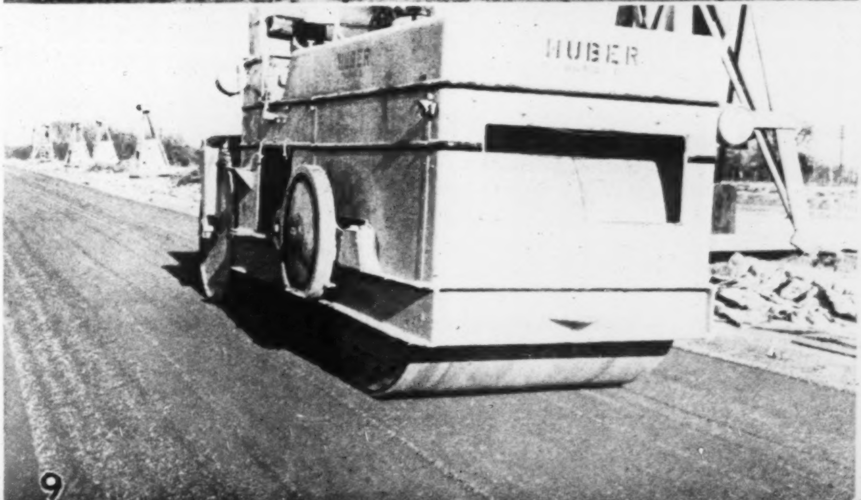

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Figs. 6-9. After thorough dry mixing of the materials, pressure distributors apply water in several applications as mixing and compaction continue. As rolling with the sheepsfoot roller nears completion a job-made nail drag (Fig. 7) removes the surface irregularities. Then pneumatic-tired rollers (Fig. 8) followed by 10-ton, tandem rollers (Fig. 9) complete the construction operations. Note smooth knit surface behind the rollers.

intervals of about 30 ft. Likewise, the bond at the longitudinal joint between adjacent lanes is very good. To provide suitable transverse joints at the ends of the slabs, wooden headers were installed after the final rolling.

Drainage of the pavement is obtained by a one percent slope across the 730-ft. width.

For paving alternate lanes 500 to 1,000 ft. in length the following machinery proved very satisfactory: three rotary tillers, including one for a reserve; four sheepsfoot rollers of three-ton weight; two gange plows of the four-bottom type; one pressure distributor; one job-made nail harrow; one springtooth harrow; one flat roller; one pneumatic roller; several tractors; and about 25 trucks. A tractor was not needed for each piece of equipment, since all the tools were not operated at once. With this equipment and a 75-man crew it was possible to construct 8,000 to 10,000 sq.yd. of pavement in a day.

The total contract cost per square yard for the runways and taxiways at the previously mentioned airport is 75¢. This includes all labor, as well as equipment operators, materials, and miscellaneous expenses to build the "chat-cement" base course.

Experiments with sub-bases

As part of the work in paving the parking area, experiments with various types of sub-bases were carried out. For one study, a 4-in. sub-base of river sand was tried, but this did not support the sheepsfoot rollers properly, since the sand mixed with the materials for the slab. In addition, in the pneumatic rolling of the subbase the sand "crawled" in front of the rollers.

A 4-in. thick layer of the A-4 type of soil was also used as a sub-base, but water penetrating the finished pavement proved very detrimental, making the soil unstable. An asphaltic seal covered with sand was found to be little better, although at another point the addition of A-4 type of soil to the sand proved satisfactory. In still another location a sub-base of chats was employed, but this proved undesirable, since to distinguish between the chat sub-base and the pavement materials was difficult. Naturally this complicated the construction operations.

From experience to date, certain suggestions can be offered to those who might be planning construction of similar pavements. They are briefly as follows:

A good firm sub-base is most desirable as it keeps the sheepsfoot rollers from mixing the sub-base and pavement materials. A turn-around about 50-ft. wide should be provided at each end of the lanes under construction. The advice of a soils engineer is of great value and his help is a necessity on most jobs. Slightly more material should be mixed than is actually necessary for the lane under construction; this makes for easier work in getting the lane down to grade and to the level of the neighboring lane.

The parking area was paved under a fixed-fee contract held jointly by Manhattan Construction Co., Muskogee, Okla., and Long Construction Co., Kansas City, Mo. Quay Franklin was general superintendent and R. H. Pennartz, engineer. For the U. S. Corps of Engineers, Maj. R. F. Seedlock, executive assistant to District Engineer Lt. Col. H. A. Montgomery, and E. A. Cornell, area engineer, were in charge.

British Emergency Buildings Made from Precast Concrete

CONCRETE MAKERS in all parts of the British Isles are now busy turning out precast concrete posts, slabs, panels and beams for large-scale use in the B.C.F. system for emergency buildings, which was drawn up by the British Concrete Federation on the basis of instructions received from the Ministry of Works and Buildings.

The standard building — used equally for housing, schools, offices, emergency shop centers, canteens, medical services—is a 7.5 ft. high rectangular one-story hall 18.5 x 52 ft., providing an internal accommodation volume of about 6,800 cu.ft.

Walls are erected of precast reinforced concrete. External walls consist of 1½-in. cavity formed between an external panel of dense pressed concrete 1½ in. thick and an internal panel of lightweight breeze concrete 2 in. thick and give a high degree of thermal insulation. Internal walls, where used, are of 2 or 3-in. breeze concrete.

The posts—of standard size and form (6 x 4, 4½ x 4, 5 x 5, and 5½ x 4½ ft.) designed to give maximum economic structural rigidity—are located in sockets formed in the foundations, grouted in position and pointed up. The walls are located in slots in the posts, bedded in position and pointed up.

The roof of unreinforced breeze concrete slabs is laid on precast reinforced-concrete roof beams doweled and grouted to the posts. It is 4 in. thick and gives complete protection against 2.2 lb. incendiary bombs. The space between the eaves slab of special unreinforced breeze concrete on top of the wall panels and the roof slabs is filled with poured-in-place concrete, and the member so produced is reinforced with a single ⅜-in. rod running parallel to the external walls that is tied to the post beam dowels and adds considerably to the strength of the structure. The roof slabs are grouted together, lightly screeded, and finished with bitumen mastic felt cemented in position with hot bitumen.

For the windows of standardized metal design special precast concrete jambs, sills and heads are provided. Wood doors are fitted to lightweight timber framing attached in turn to precast concrete posts.

The materials used for the standard building include about 18 long tons of precast concrete, some 14 long tons of precast breeze concrete, and 1,600 lb. of steel for reinforcement; the requirements of timber, bitumen and similar substances are quite small.

Much use can be made of unskilled labor if proper organization is provided, especially if new workers are allowed to get some experience working with skilled building laborers before being given separate jobs.

The emergency building has been designed with a view to giving reasonable protection against bombs. Not only does the thick roof protect against incendiaries, but the building is also designed to stand up well to blast and high explosives. Adaptation of the interior to special needs is also carried out according to standard designs.

Construction Techniques Changed by Camouflage Requirements

Carrying On construction operations with the least possible disturbance to grass, shrubs and trees is becoming a necessity on many military jobs where the concealment offered by such natural ground cover is important. No longer can trucks be allowed to cut deep ruts promiscuously, nor can trees be cut down when they are in the way. Even materials must be piled in places not easily observed from the air, and excavation backfills must be carefully tamped to avoid settlement that would reveal the locations of facilities. Changed construction techniques will be necessary to meet these requirements, and some of the necessary practices are outlined in the specifications recently issued for one of these camouflaged military establishments.

Major emphasis is placed on the protection of trees. Only those that are actually in an area to be occupied by a building or other facility may be removed, and usually such trees are required to be replanted elsewhere. Trees 6 in. or more in dia. near roadways must be protected by 1-in. boards to a height of 10 ft. In some cases trees occurring in the shoulder areas of roadways are not allowed to be removed. Sometimes a single tree occurs within a construction area, and in such cases a 6 to 10-ft. radius barricade must be built around it to preserve aeration of the root system.

The specifications also point out that when trees 4 in. or more in dia. occur more than 4 ft. from buildings, branches 2 in. in dia. or more are not to be disturbed. In cases where tree roots have to be uncovered, it is required that a 6-in. layer of top soil be placed over them as soon as possible. Furthermore, if this dirt cover cannot be applied within a reasonable time, it is necessary to cover the roots with a temporary protection of cotton quilts that are wet down periodically.

Work areas in this specification are defined as follows: For a one-story building, 10 ft. out from the wall line, and in addition there may be a 10-ft. access to the street; for a two-story building or a hangar, 15 ft. out from the wall line and in addition a 10-ft. access to the street. For runways, taxiways and roads, the limits of grading and filling define the limits of the work area; and for ditches the work may extend to either side a distance equal to the depth of the cut.

In certain cases grades may have to be raised in areas where trees occur. Where this raise in grade is more than 6 in., a 6-in. layer of loose, coarse gravel is required to be placed in a 10 or 12-ft. radius circle around the tree, after which earthfill and top soil may be placed over the gravel. Where the fill exceeds 1 ft. and the tree is 8 in. or more in dia., dry-stone walls must be built around the tree 3 ft. from the trunk.

Care is required to be exercised so that trees otherwise protected will not be damaged. For example, scaffolding must not be nailed to trees, and under no circumstances are workmen to use climbing irons. All scars that are over 1 in. in dia. must be treated with a mixture of white lead and lamp black, or a standard tree paint.

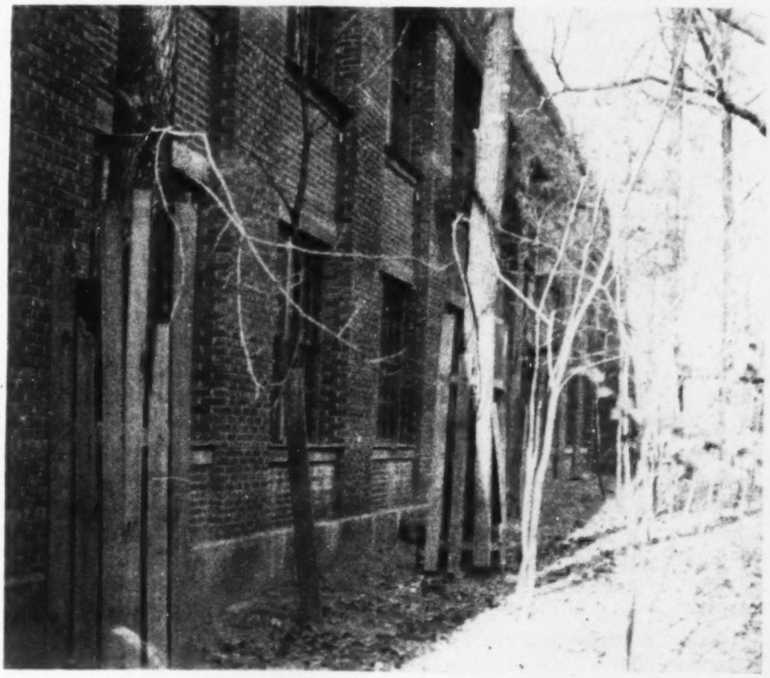


Fig. 1. Preservation of nearby trees during construction is often required in order that the foliage will aid in concealing the completed building from the air.

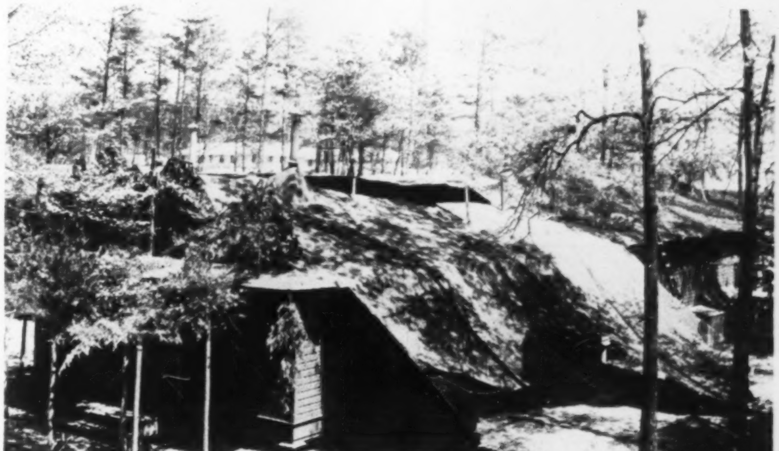


Fig. 2. For low structures the concealment methods illustrated above may be very effective. Note how the neighboring trees were left undisturbed.

Air-Raid Organization Measures For Water Supply Protection

Contents in Brief—*Plans for the protection and repair of public works in case of air raids and sabotage have been carefully developed by Chicago's bureau of engineering. One of the most important procedures outlined is that dealing with emergency protective measures for the city's water supply. The following describes the organization, personnel, duties and equipment of the water safety units that have been established.*

In Anticipation of enemy action causing damage to public works in Chicago, each division and bureau of the city's department of public works has developed a civil defense plan and organization for protection and repair of various facilities. Organization and procedure have been outlined in a series of manuals, one of which applies to the safety of Chicago waterworks. A similar procedure for protection of Chicago sewers was outlined in *ENR* Mar. 12, 1942, p. 113.

Each manual contains a narrative of a mythical air raid, often accompanied by sabotage, resulting in damage to specific public works facilities. The story describes the attack, the damage done, and how repairs, resumption of service and protection of the public were effected. Full details of the organization and duties of each squad or unit are given, along with equipment and tools made available.

The waterworks safety manual points out that in the development of plans for safety of the water supply two fundamental assumptions were made:

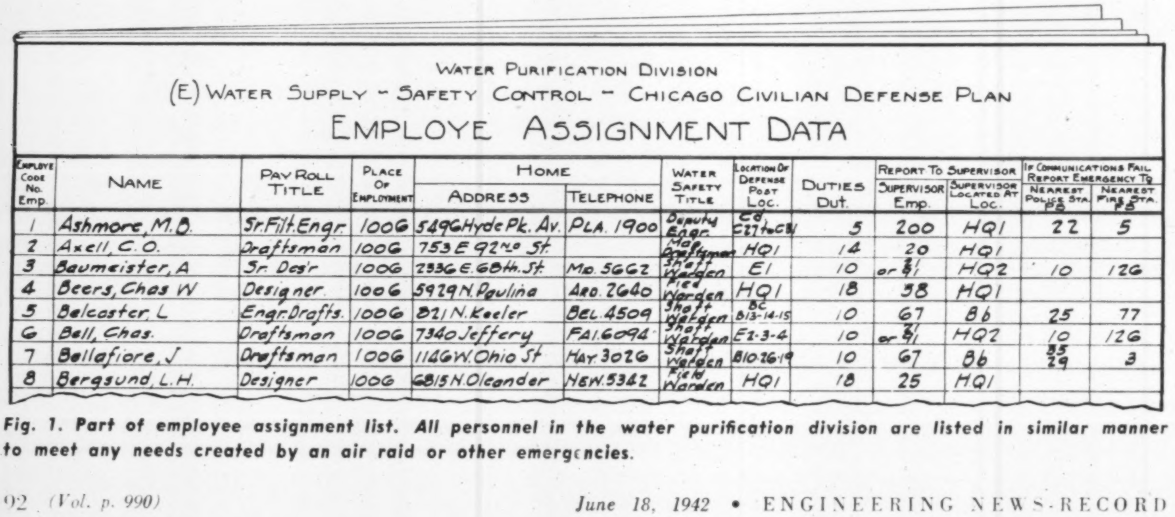
1. That the Civilian Defense Organization of the Chicago metropolitan area is the official agency through which reports of enemy action will be received, through which essential warnings and instructions to the public will be issued and through which essential transportation will be obtained during extreme emergencies; and

2. That the technical direction and operation necessary for safeguarding the public water supply will be the responsibility of the Division of Water Purification, and that all men, materials and equipment necessary to discharge this responsibility will be made available for emergency use and be supplemented with additional equipment.

Plans for emergency protection of the city's water supply are primarily an expansion of the emergency services that this division, in cooperation with other divisions and bureaus, have been rendering for years. Since water is an essential utility, anything that affects its service is of concern to every citizen. Therefore, during a serious emergency the public must be informed of any threatened interruption of this service.

Each citizen will be advised how he can cooperate with defense and water supply officials, such as being warned against excessive use of water during a threatened air raid, which might reduce the pressure and create a health hazard, and to keep on hand at all times in proper containers an emergency supply for drinking purposes. Since it must be assumed that in times of emergency the safety of the water supply may be in jeopardy, the public will be informed by radio and by other means not to drink water from the city system until further announcements are made. During this time drinking water should either be boiled or obtained from an emergency supply.

Another safety measure to be taken during a general emergency period is to substantially increase the amount of chlorine applied to the water at pumping stations. This general increase will be at the rate of 3 lb. per million gallons of water pumped, and a standing order to this effect has been given to engineers at the pump-



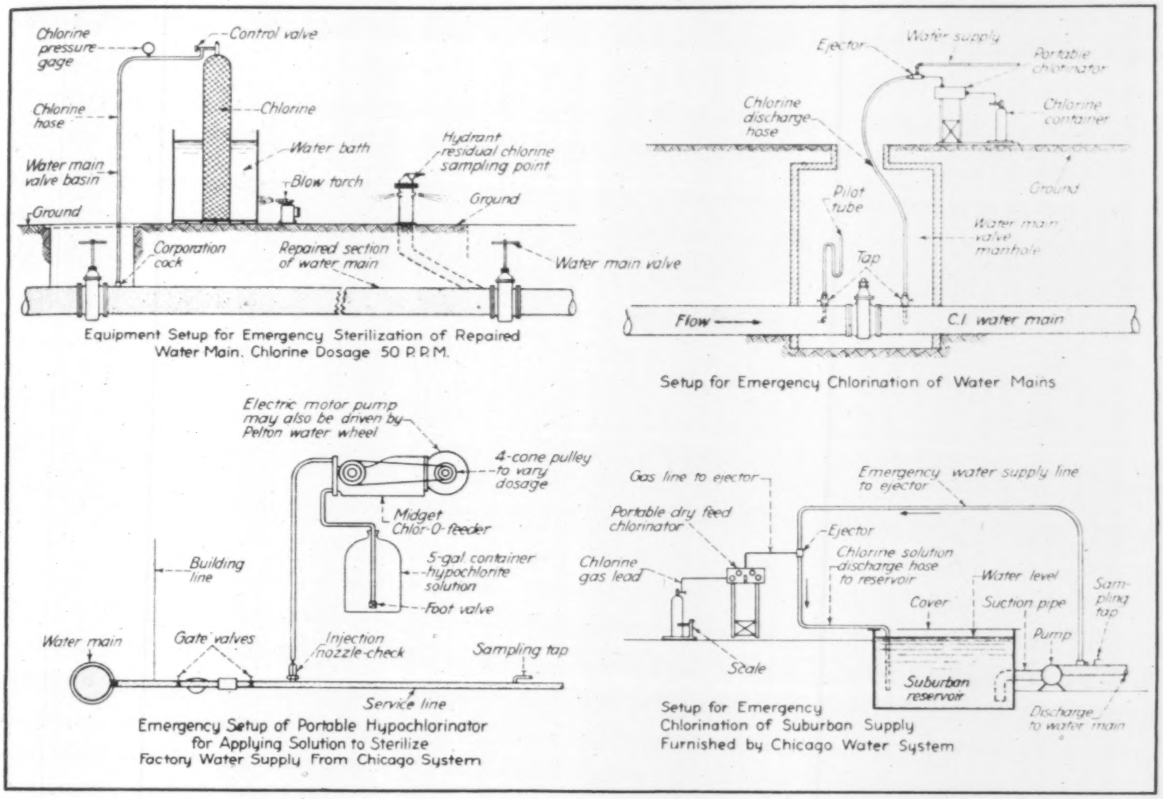
Water Purification Division

(E) Water Supply - Safety Control - Chicago Civilian Defense Plan

Employe Assignment Data

Employe Code No. Emp.	Name	Pay Roll Title	Place of Employment	Home		Water Safety Title	Location of Defense Post Loc.	Duties Dut.	Report To Supervisor		If Communications Fail Report Emergency To	
				Address	Telephone				Supervisor Emp.	Supervisor Located At Loc.	Nearest Police Sta. PS	Nearest Fire Sta. FS
1	Ashmore, M.B.	Sr. Filt. Engr.	1006	5496 Hyde Pk. Av.	PLA. 1900	Deputy Engr.	Cd. C27toC3	5	200	HQ1	22	5
2	Axell, C.O.	Draftsman	1006	753 E 92nd St.		Map Draftsman	HQ1	14	20	HQ1		
3	Baumeister, A	Sr. Des'r	1006	2336 E. 68th. St.	Mo. 5662	Shaft Warden	E1	10	21 or 91	HQ2	10	126
4	Beers, Chas W	Designer	1006	5929 N. Paulina	Ard. 2640	Field Warden	HQ1	18	38	HQ1		
5	Belcaster, L	Engr. Drafts.	1006	821 N. Keeler	Bel. 4509	Shaft Warden	BC B13-14-15	10	67	8b	25	77
6	Bell, Chas.	Draftsman	1006	7340 Jeffery	FAI. 6094	Shaft Warden	E2-3-4	10	21 or 91	HQ2	10	126
7	Bellafiore, J	Draftsman	1006	1146 W. Ohio St	Hay. 3026	Shaft Warden	B10-26-19	10	67	8b	35 29	3
8	Bergsund, L.H.	Designer	1006	6815 N. Oleander	New. 5342	Field Warden	HQ1	18	25	HQ1		

Fig. 1. Part of employee assignment list. All personnel in the water purification division are listed in similar manner to meet any needs created by an air raid or other emergencies.



Equipment Setup for Emergency Sterilization of Repaired Water Main. Chlorine Dosage 50 P.P.M.

Setup for Emergency Chlorination of Water Mains

Emergency Setup of Portable Hypochlorinator for Applying Solution to Sterilize Factory Water Supply From Chicago System

Setup for Emergency Chlorination of Suburban Supply Furnished by Chicago Water System

Chlorine pressure gage
Control valve
Chlorine hose
Chlorine
Water bath
Water main valve basin
Blow torch
Hydrant residual chlorine sampling point
Ground
Ground
Corporation cock
Repaired section of water main
Water main valve
Ejector
Water supply
Portable chlorinator
Chlorine discharge hose
Chlorine container
Ground
Pilot tube
Water main valve manhole
Tap
Flow
C.I. water main
Electric motor pump may also be driven by Pelton water wheel
4-cone pulley to vary dosage
Midget Chlor-O-feeder
5-gal container hypochlorite solution
Foot valve
Building line
Water main
Gate valves
Injection nozzle-check
Sampling tap
Service line
Gas line to ejector
Emergency water supply line to ejector
Portable dry feed chlorinator
Ejector
Chlorine solution discharge hose to reservoir
Chlorine gas lead
Water level
Cover
Suction pipe
Sampling tap
Pump
Scale
Suburban reservoir
Discharge to water main

Fig. 2. Emergency chlorination installations devised to meet typical conditions resulting from air-raid damage.

ing stations to become effective at the time of a general warning by the Civilian Defense organization, subject to formal check and verification at the Division of Water Purification.

Such practice is already standard procedure at Chicago pumping stations in case of large fires where abnormal use of water might result in the introduction of pollution. As soon as all shaft wardens on any one tunnel system report no damage, the chlorine dose is reduced to normal on that system.

General organization plan

Organization of the water system protective plan has been worked out in elaborate detail. Two headquarters have been established, No. 1 at the offices of the water filtration section in the city hall and No. 2 at the water safety control section of the experimental filter plant on the south side of the city. Facilities are available at headquarters No. 2 for making a special water analysis.

Functionally, the organization meets three distinct defense needs: (1) Prompt coverage of vulnerable points in the water system with provisions for early remedial action to protect the public health; (2) Prompt and effective system of emergency chlorination; (3) Education and training of employees in emergency safety work.

In general, the functional organization of each of the two headquarters is similar. Most significant difference is that the greater percentage of employees at No. 1 are designing engineers and not sanitary engineers. The designers are employed in the filtration design section, and most of them have a basic engineering education, specializing in structural, mechanical, electrical and architectural engineering. They are now being instructed in the basic practices of sanitary engineering.

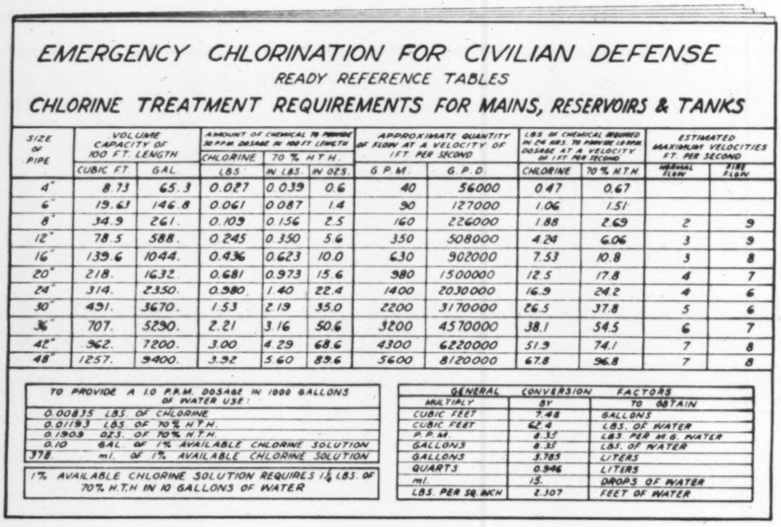
Men assigned to headquarters No. 2 are mostly sanitary engineers, and include water samplers, dredging inspectors, draftsmen and clerks. Their principal duties are supervision of the chlorination of the city's water supply, investigation of conditions pertaining to water supply and public health and prevention of pollution of the lake.

The water safety organization is a unit of the public works section of the Civilian Defense headquarters. It includes 109 men and 9 women. The unit is headed by a chief water safety engineer, in charge of headquarters No. 1, with an assistant chief water safety engineer, second in command and in charge at headquarters No. 2. Three deputy water safety engineers report directly to the chief engineer and provide the liaison between the water safety organization and other waterworks units in the area.

Warden and squad duties

The Chicago water system involves miles of tunnels and numerous shafts. Therefore, attention has been paid to possible damage to the shafts. At No. 1 headquarters there are three squads of shaft wardens each in charge of a deputy water safety engineer, and at No. 2 headquarters there are two of these squads. There is a squad of shaft wardens for each of the four major tunnel systems, and at least one warden has been assigned to each tunnel shaft. There are five organized field squads at the headquarters No. 1, trained for special assignments to control points in the waterworks system.

At headquarters No. 2 there are eight organized technical squads,



EMERGENCY CHLORINATION FOR CIVILIAN DEFENSE

READY REFERENCE TABLES

CHLORINE TREATMENT REQUIREMENTS FOR MAINS, RESERVOIRS & TANKS

SIZE OF PIPE	VOLUME CAPACITY OF 100 FT. LENGTH		AMOUNT OF CHEMICAL TO PROVIDE 50 P.P.M. DOSAGE IN 100 FT LENGTH			APPROXIMATE QUANTITY OF FLOW AT A VELOCITY OF 1 FT. PER SECOND		LBS. OF CHEMICAL REQUIRED IN 24 HRS. TO PROVIDE 1.0 PPM DOSAGE AT A VELOCITY OF 1 FT. PER SECOND		ESTIMATED MAXIMUM VELOCITIES FT. PER SECOND	
			CHLORINE	70 % H.T.H.							
	CUBIC FT.	GAL.	LBS.	IN LBS.	IN OZS.	G.P.M.	G.P.D.	CHLORINE	70 % H.T.H.	NORMAL FLOW	FIRE FLOW
4"	8.73	65.3	0.027	0.039	0.6	40	56000	0.47	0.67		
6"	19.63	146.8	0.061	0.087	1.4	90	127000	1.06	1.51		
8"	34.9	261.	0.109	0.156	2.5	160	226000	1.88	2.69	2	9
12"	78.5	588.	0.245	0.350	5.6	350	508000	4.24	6.06	3	9
16"	139.6	1044.	0.436	0.623	10.0	630	902000	7.53	10.8	3	8
20"	218.	1632.	0.681	0.973	15.6	980	1500000	12.5	17.8	4	7
24"	314.	2350.	0.980	1.40	22.4	1400	2030000	16.9	24.2	4	6
30"	491.	3670.	1.53	2.19	35.0	2200	3170000	26.5	37.8	5	6
36"	707.	5290.	2.21	3.16	50.6	3200	4570000	38.1	54.5	6	7
42"	962.	7200.	3.00	4.29	68.6	4300	6220000	51.9	74.1	7	8
48"	1257.	9400.	3.92	5.60	89.6	5600	8120000	67.8	96.8	7	8

TO PROVIDE A 1.0 P.P.M. DOSAGE IN 1000 GALLONS OF WATER USE:	
0.00835	LBS. OF CHLORINE
0.01193	LBS. OF 70% H.T.H.
0.1909	OZS. OF 70% H.T.H.
0.10	GAL. OF 1% AVAILABLE CHLORINE SOLUTION
378.	ml. OF 1% AVAILABLE CHLORINE SOLUTION

1% AVAILABLE CHLORINE SOLUTION REQUIRES 1¼ LBS. OF 70% H.T.H IN 10 GALLONS OF WATER

GENERAL CONVERSION FACTORS		
MULTIPLY	BY	TO OBTAIN
CUBIC FEET	7.48	GALLONS
CUBIC FEET	62.4	LBS. OF WATER
P.P.M.	8.35	LBS. PER M.G. WATER
GALLONS	8.35	LBS. OF WATER
GALLONS	3.785	LITERS
QUARTS	0.946	LITERS
ml.	15.	DROPS OF WATER
LBS. PER SQ. INCH	2.307	FEET OF WATER

Fig. 3. Time is precious in an emergency, so this chart was prepared to eliminate the need for making calculations for chlorine treatment under various conditions.

each including a sanitary engineer (called water safety technical squad leaders) and two assistants (called water safety technicians). Their function is to carry out the emergency field work where special technical knowledge and experience is required in the use and control of chlorine.

Following is the manner in which the 118 members of the water safety organization have been designated:

Chief engineer	1
Assistant chief engineer	1
Deputy engineers	11
Technical squad leaders	8
Field squad leaders	5
Shaft wardens	27
Field wardens	18
Technicians	18
Chemists	2
Map draftsmen	2
Clerks	5
Telephone operators	11
Messengers	5
Chlorine control engineers	4

Each employee has been given an identification number for convenience in codifying his duties and assignment. All employees are listed on a chart which has been reproduced and widely distributed, giving their name, code numbers, payroll title, place of employment, home address and telephone number, water safety title, location of his defense post and duties, supervisor, post of supervisor, location of police and fire station nearest his post. A part of this chart is shown in Fig. 1.

If the emergency occurs while the employees are enroute to or from their homes it will be necessary to wait until he arrives either at home or office, but this period of noncontact will not be longer than one hour. Each employee carries with him at all times a complete list of names, address and telephone numbers of subordinates and superiors.

Records and supplies are prepared for the field men. The first men to arrive drive the automobiles from the garage to the headquarters No. 2 where the cars are loaded with emergency equipment. Superiors in charge direct the men to their assigned posts. All city-owned field cars assigned to the division are to be equipped with radio receiving sets to maintain communication at all times. If necessary a police car with two-way radio equipment will be used to transmit emergency orders.

For educational purposes the manual lists several types of possible disasters to shafts, pumping stations and water mains. The water safety unit does not do any repair work, however, such work being the function of the construction forces. The safety unit is concerned only with emergency sterilization of the water.

Three courses totalling 16 lectures have been prepared to train the personnel of the water purification division in its civilian defense duties. Five lectures in an elementary training course will be given to all employees. Three lectures of advanced training will be given to shaft wardens, field wardens, technicians and messengers. An advanced and much more technical training course of eight lectures has been prepared for the engineers and chemists serving as technical squad leaders and deputy water safety engineers.

A list of equipment required for the various operations of the water safety units is given in an accompanying table. Each water safety squad is equipped with field chlorinating equipment, tools, gas mask, flashlight and protective clothing. This equipment is in addition to two plant chlorinators, a hypochlorinator and various accessories stored at headquarters No. 2. As a precaution against possibility of destruction of headquarters No. 2 additional emergency equipment is stored at three

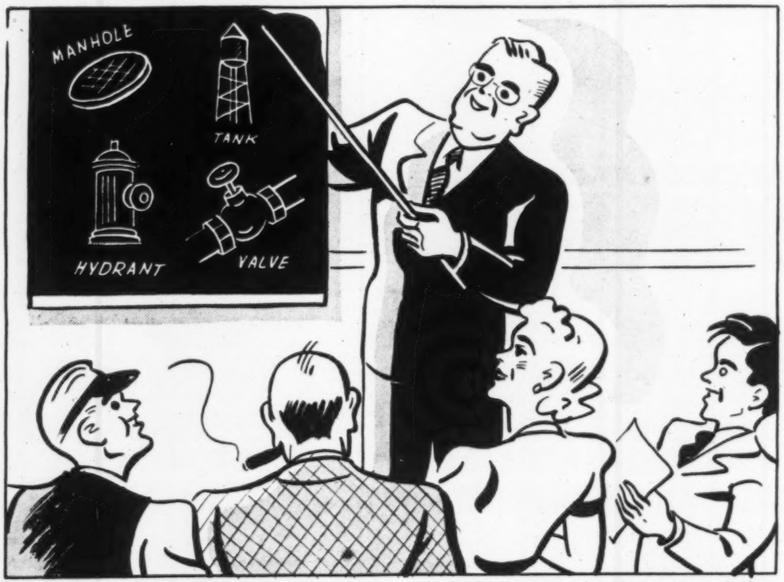


Fig. 4. Part of the elementary training course in water supply emergency duties consisted of five lectures, attended by all employees of the division.

EQUIPMENT FOR EMERGENCY WATER PROTECTION OPERATIONS

Chlorination and Tests

1—300 lb/day gas chlorinator
1—25 lb/day gas chlorinator
1—Portable hypochlorinator, elec. or water drive
3—Portable hypochlorinator, gas engine drive
8—Silver tube main diffusers for chlorine
16—Assemblies for chlorinating direct from chlorine cylinder to main
2—Portable 300 lb/day emergency chlorinating trailer trucks
180—Emergency field kits
600 ft.—Chlorine hose, heavy wall, ½ in.
600 ft.—Chlorine hose, heavy wall, ⅜ in.
600 ft.—Chlorine hose, heavy wall, ¼ in.
30—Auxiliary chlorine valves
20—Chlorine gas masks
2—Complete 10-lead chlorine manifold assemblies
12—Suits protective clothing
48—sets rubber boots, coats and hats
48—Flashlights
12—Battery lanterns
900 lb.—Calcium hypochlorite, 70%
2—Fresh air gas masks with hose
12—Sets tools for emergency chlorination
7—Short wave radios

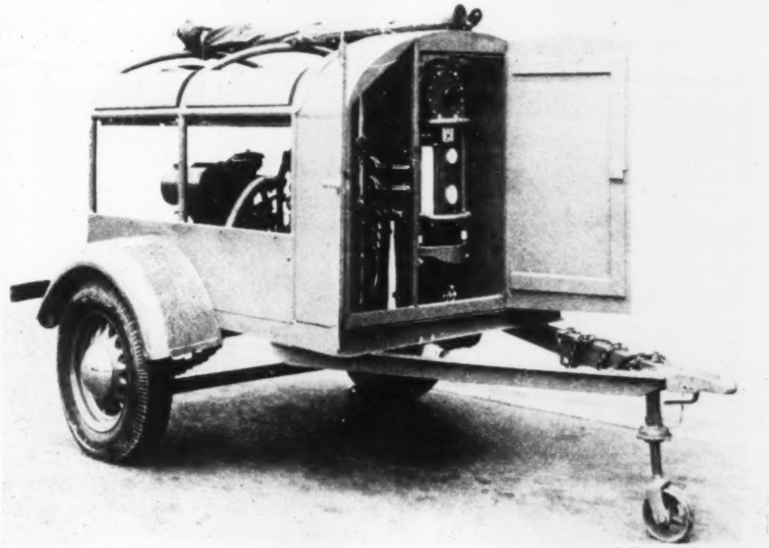
Technical Squad Equipment

1—100 lb. cylinder of chlorine
1—Chlorinating assembly (aux. valve, pressure gage, 15 ft. ⅜-in. hose, corporation cock connection.
1—Chlorine gas mask
1—Battery lantern
3—Flashlights
1—Tool case containing:
    Corporation cock wrench
    Hammer
    Screwdriver
    Pliers
    Chl. cyl. valve wrench
    14-in. Stillson wrench
    8-in. Stillson wrench
    12-in. monkey wrench
    8-in. monkey wrench
    Spanner wrenches (set of 6—7/16 to 1 1/16 in.)
    Roll friction tape
    Assortment lead and fibre gaskets
1—Hank rope
1—Suit protective clothing
3—Pr. rubber boots, hats, coats

Note: Spare equipment assemblies as above also stored at headquarters and district offices.

Emergency Field Kits

1—5 lb. can 70% calcium hypochlorite
1—Set of 3 residual chlorine color standards, 3 extra test bottles
1—Bottle orthotolidine solution
1—Ml. pipette with rubber bulb
12—Sterilized bottles for bacterial samples
6—Sterilized bottles containing dechlorinating agent for bacterial samples
1—Package record cards, and labels



Wallace & Tiernan Co. photo

Fig. 5. Mobile chlorinator of 300-lb capacity, completely equipped for all emergency needs in connection with water sterilization.

district offices and at headquarters No. 1.

Field kits have been prepared for each of the deputy engineers, technical squad leaders, field squad leaders, shaft wardens, field wardens and technicians. Each field worker will be supplied with two kits, one to be stored at home and the other at the headquarters to which he is assigned.

A list and description of 21 different duties has been prepared, and each employee of the water safety unit is assigned to one of these duties. General duties, applicable to all, are: (1) Immediately after hearing an air raid alarm or upon receipt of notification of an emergency, proceed at once to your assigned post, using any means of transportation then available; (2) As soon as you arrive at your post report to your superior; (3) Remain on duty until you are released by superior or are relieved.

As an example of the various activities included in a specific duty assignment, one of them is listed in detail in the following tabulation.

DUTY No. 8—WATER SAFETY TECHNICAL SQUAD LEADER:

1. Post, HQ 2. In certain cases you may receive definite orders from the assistant chief water safety engineer to proceed to a particular field location.

2. In case an emergency service alarm after office hours notify the water safety technician assigned to your squad to proceed at once to HQ 2 or a particular field location.

3. Report to the assistant chief water safety engineer and await orders.

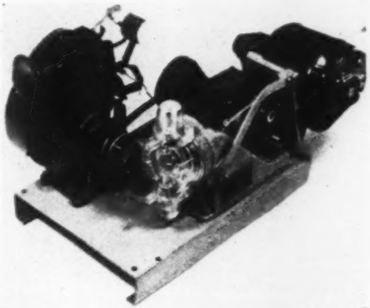
4. Check up to see if the water safety technicians assigned to your squad have arrived and if not, contact them.

5. Lay out and check all emergency chlorinating equipment and accessories, check condition of automobiles used for transportation, gas, oil, tires, etc.

6. When an assignment is received from the assistant chief water safety engineer, proceed immediately with water safety technicians and the necessary equipment to the scene of the emergency. Set up emergency chlorine equipment and carry out any precautionary measures that may be necessary to maintain the safety of the water supply.

7. Contact the safety shaft wardens and the deputy water safety engineer in charge of the particular area and other Bureau personnel assigned to the emergency.

8. As soon as possible make a preliminary report to the assistant chief water safety engineer of the extent of damage and pollution in emergency work performed by you.



Proportioneers, Inc. photo

Fig. 6. Compact, heavy-duty hypochlorite feeder, equipped with both gasoline-engine and electric motor.

The manual concludes with a list of all special waterworks structures to be safeguarded, giving the code number, location and type of structure, the employees assigned to this particular structure, and the nearest fire and police station. It was prepared by Arthur E. Gorman, assistant city engineer in charge of water purification, under the general direction of W. W. DeBerard, city engineer, O. W. Hewitt, commissioner of public works, and Mayor Edward J. Kelly, coordinator of civilian defense activities for the entire Chicago metropolitan region.

From Field and Office

Working problems and time-saving methods for engineers and contractors

Tables Save Much Time in Calculating Fixed-End Moments

While fixed-end moments may be ascertained in each individual case by use of the area-moment principle, outlined by John Vamosi in *ENR*, March 26, 1942, p. 502, or by other methods such as the "column analogy," the designer confronted with a great amount of work will resort to prepared tables to save time. The writer for a number of years has used the two accompanying tables for determining fixed-end moments in prismatic beams. The tables are applicable to all types of loading. Fixed-end moments for uniform partial loading can be obtained as shown in Fig. 1, and for triangular or variable loading by substituting a series of concentrated loads.

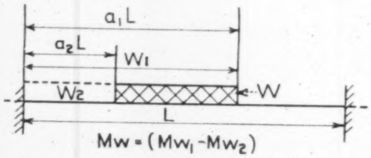
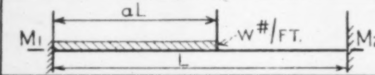


Fig. 1. Fixed-end moments for uniform partial loading can be obtained by the formula given above.

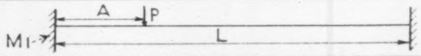
Tables such as those supplied by C. J. Posey in *ENR*, Nov. 6, 1941, p. 671, will save much effort finding the fixed-end moments for t angular loading, but they should extended to avoid interpolation. M. W. ROSENSTEIN, *Structural En neer, 5513 Everett Ave., Chicago, I*



F.E.M. = M_1wL^2 & M_2wL^2

a	M_1	M_2	a	M_1	M_2	a	M_1	M_2	a	M_1	M_2	a	M_1	M_2
.01	.00005	.00000	.21	.01636	.00260	.41	.04517	.01591	.61	.06934	.04105	.81	.08137	.06953
.02	.00019	.00000	.22	.01769	.00296	.42	.04659	.01692	.62	.07026	.04250	.82	.08165	.07076
.03	.00043	.00001	.23	.01904	.00336	.43	.04799	.01796	.63	.07113	.04397	.83	.08190	.07195
.04	.00076	.00002	.24	.02061	.00378	.44	.04938	.01902	.64	.07198	.04544	.84	.08213	.07310
.05	.00117	.00004	.25	.02181	.00423	.45	.05075	.02012	.65	.07279	.04692	.85	.08234	.07421
.06	.00166	.00007	.26	.02323	.00472	.46	.05210	.02125	.66	.07357	.04840	.86	.08251	.07527
.07	.00223	.00011	.27	.02466	.00523	.47	.05343	.02241	.67	.07432	.04988	.87	.08267	.07628
.08	.00287	.00016	.28	.02610	.00578	.48	.05474	.02359	.68	.07503	.05136	.88	.08281	.07723
.09	.00358	.00023	.29	.02756	.00636	.49	.05603	.02480	.69	.07571	.05284	.89	.08293	.07813
.10	.00436	.00031	.30	.02902	.00698	.50	.05729	.02604	.70	.07636	.05431	.90	.08302	.07898
.11	.00520	.00041	.31	.03050	.00762	.51	.05853	.02730	.71	.07697	.05577	.91	.08311	.07975
.12	.00610	.00052	.32	.03198	.00830	.52	.05974	.02859	.72	.07755	.05723	.92	.08317	.08046
.13	.00706	.00066	.33	.03346	.00901	.53	.06092	.02990	.73	.07810	.05868	.93	.08322	.08111
.14	.00807	.00082	.34	.03494	.00976	.54	.06208	.03123	.74	.07862	.06011	.94	.08326	.08167
.15	.00913	.00100	.35	.03642	.01054	.55	.06321	.03258	.75	.07910	.06152	.95	.08329	.08216
.16	.01023	.00120	.36	.03790	.01135	.56	.06431	.03395	.76	.07955	.06292	.96	.08331	.08258
.17	.01138	.00143	.37	.03937	.01220	.57	.06538	.03534	.77	.07998	.06429	.97	.08332	.08290
.18	.01257	.00168	.38	.04083	.01308	.58	.06642	.03675	.78	.08037	.06565	.98	.08333	.08314
.19	.01380	.00196	.39	.04229	.01399	.59	.06742	.03817	.79	.08073	.06697	.99	.08333	.08328
.20	.01507	.00227	.40	.04373	.01493	.60	.06840	.03960	.80	.08107	.06827	1.00	.08333	.08333

Table I. Fixed-end moments for uniform loading of prismatic beams.

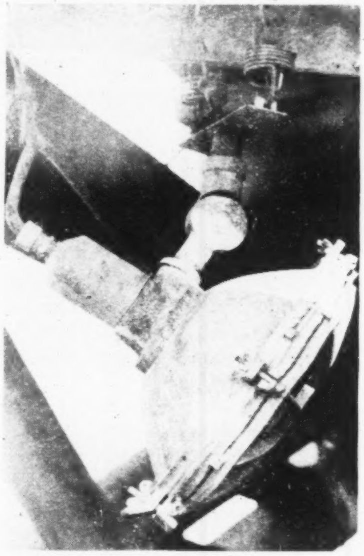


A/L	M_1	A/L	M_1	A/L	M_1	A/L	M_1	A/L	M_1
.01	−.0098 PL	.21	−.1311 PL	.41	−.1427 PL	.61	−.0928 PL	.81	−.0292 PL
.02	.0192 "	.22	.1338 "	.42	.1413 "	.62	.0895 "	.82	.0266 "
.03	.0282 "	.23	.1364 "	.43	.1397 "	.63	.0862 "	.83	.0240 "
.04	.0369 "	.24	.1386 "	.44	.1380 "	.64	.0829 "	.84	.0215 "
.05	.0451 "	.25	.1406 "	.45	.1361 "	.65	.0796 "	.85	.0191 "
.06	.0530 "	.26	.1424 "	.46	.1341 "	.66	.0763 "	.86	.0169 "
.07	.0605 "	.27	.1439 "	.47	.1320 "	.67	.0730 "	.87	.0147 "
.08	.0677 "	.28	.1452 "	.48	.1298 "	.68	.0696 "	.88	.0127 "
.09	.0745 "	.29	.1462 "	.49	.1274 "	.69	.0663 "	.89	.0108 "
.10	.0810 "	.30	.1470 "	.50	.1250 "	.70	.0630 "	.90	.0090 "
.11	.0871 "	.31	.1476 "	.51	.1225 "	.71	.0597 "	.91	.0074 "
.12	.0929 "	.32	.1480 "	.52	.1198 "	.72	.0564 "	.92	.0059 "
.13	.0984 "	.33	.1481 "	.53	.1171 "	.73	.0532 "	.93	.0046 "
.14	.1035 "	.34	.1481 "	.54	.1143 "	.74	.0500 "	.94	.0034 "
.15	.1084 "	.35	.1479 "	.55	.1114 "	.75	.0469 "	.95	.0024 "
.16	.1129 "	.36	.1475 "	.56	.1084 "	.76	.0438 "	.96	.0015 "
.17	.1171 "	.37	.1469 "	.57	.1054 "	.77	.0407 "	.97	.0009 "
.18	.1210 "	.38	.1461 "	.58	.1023 "	.78	.0377 "	.98	.0004 "
.19	.1247 "	.39	.1451 "	.59	.0992 "	.79	.0348 "	.99	.0001 "
.20	.1280 "	.40	.1440 "	.60	.0960 "	.80	.0320 "	1.00	.0000 "

Table II. Fixed-end moments for concentrated loading of prismatic beams.

Flexible Light Supports Reduce Maintenance of Equipment

Because the vibration of a heav piece of equipment was greatly shortening the life of the unit's shielde floodlights, a Texas contracto mounted the light sources on standar adjustable brackets and then supported each of the plates onto which the brackets were screwed by a pair of coiled springs. This arrangement, which is illustrated in an accompanying photograph, reduced maintenance charges.



Use of flexible support or the shielded floodlights reduced bulb replacements on heavy construction equipment used by a Texas contractor.

The lower loops of the springs are threaded through eyes on the upper side of the plate and the springs are then hooked to heavy wires on the most convenient part of adjacent steel framework. The springs in being between the light support and the rigid mounting, absorb all the heavy vibration. The weight of the lighting fixture is sufficient to maintain the light beam in the desired direction, while the upper portion of the spring damps out the damaging impulses that would otherwise wreck the light filament.—ELTON STERRETT, *P. O. Box 6563, Houston, Texas.*

Conception, Design and Construction

of the

SOUTH DISTRICT FILTRATION PROJECT

An analysis of the function, structural features and equipment installation for the world's largest water treatment plant now nearing completion at Chicago.

Arranged and
presented by
ENGINEERING NEWS-RECORD

Written by
MEMBERS OF THE BUREAU OF ENGINEERING,
DEPARTMENT OF PUBLIC WORKS, CHICAGO

On The Job

of building the South District Project

W. W. DeBerard, city engineer, is deeply involved in every phase of the work. ←

John R. Baylis, water purification engineer, knows filters inside out. →

A. E. Gorman, assistant city engineer, has "lived" with the job from the beginning. ←

Fred B. Gordon, senior filtration engineer.

W. F. Martin and E. A. Randall ↓

M. B. Ashmore, senior filtration engineer.

F. W. Seidensticker, senior filtration designer.

Paul Gerhardt, city architect.

Into the conception, design and construction of Chicago's huge water treatment plant has gone the energies of scores of men over a long period of years. Some of those who played a role in this undertaking kindly have consented to act as spokesmen for their colleagues, and in the following pages they describe the engineering features of the project.

This contribution to technical knowledge should be considered, therefore, as a staff presentation of the Water Purification Division of the Bureau of Engineering, Department of Public Works, of which Oscar E. Hewitt is commissioner, serving under Edward J. Kelly, mayor.

Those participating directly in the preparation of material were: A. E. Gorman, assistant city engineer; J. R. Baylis, engineer of water purification; F. G. Gordon, E. A. Randall and M. B. Ashmore, senior filtration engineers; F. W. Seidensticker and W. G. Mason, senior filtration designers; L. Johnson, senior designer.

Preparation of plans, specifications and the supervision of contracts is being carried out by the Bureau of Engineering, W. W. DeBerard, city engineer; prior to February, 1941, Loran D. Gayton was city engineer. Early studies of plant layout were prepared by A. E. Gorman, then engineer of water purification, and the late Alfred W. Marshall, filtration designing engineer.

Detailed plans for the substructure were prepared under the direction of O. B. Carlisle, engineer of waterworks design, and William F. Martin, senior filtration engineer. Inspection of construction has been carried out by James J. Versluis, engineer of waterworks construction, and Carl G. Riggenbach, resident engineer. Architectural design was under the direction of Paul Gerhardt, city architect.

Consultants employed on this project have been Paul Hansen, of Greeley & Hansen; Charles B. Burdick and Louis R. Howson, of Alvord, Burdick & Howson, all of Chicago.

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A Bit of Background

CHICAGO'S STRUGGLE for a safe and satisfactory water supply, even with one of the world's great freshwater lakes at its front door, is a story quite as fascinating as the dynamic sequence of events that saw a frontier trading post grow to the nation's second largest city.

It has been the experience of all Great Lakes cities that the dual use of these bodies of water for sewage disposal and water supply sooner or later precipitated a public health problem, the only satisfactory solution of which was the installation of sewage treatment or water purification facilities. In the case of Detroit, Buffalo and Cleveland, water purification plants were built first. At Milwaukee and Chicago, installation of sewage treatment works was given precedence over water purification plants.

South District contamination

Chicago's decision in building its first filtration plant to serve the South District was a logical one. For many years the results of bacterial analysis of daily samples of water from the Dunne Crib serving this area have shown the water to be much more contaminated than that at the other lake intakes. In the decade 1920-30 industrial development of the Calumet area of Illinois and Indiana was phenomenal. As a result vast quantities of untreated sewage and industrial wastes were discharged directly into Lake Michigan, the Calumet River or the Indiana Harbor Ship Canal and thence into the lake.

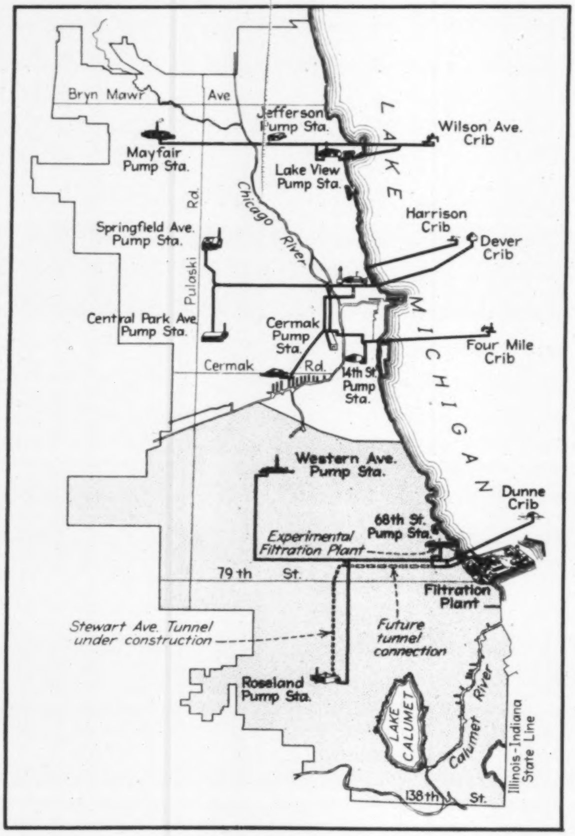
The seriousness of this situation from a public health standpoint can best be realized from the fact that then the population contributing pollution to the lake from the Indiana cities of Gary, East Chicago, Whiting and Hammond, was about 200,000; and along the Calumet River in Chicago, the contributing population was nearly 25,000.

Under the influence of southerly winds the grossly polluted waters of the lake drifted northward to the south side intakes of the Chicago supply system. At times in 1927 the discharge of phenolic compounds from byproduct coke plants at steel mills so polluted the lake waters in the vicinity of Chicago's most southerly intake that this water when chlorinated was almost undrinkable for days. Pollution in the water was of such intensity that chlorine used for disinfection rapidly was absorbed, thus creating a serious health hazard. Chlorination was being stretched beyond any reasonable health limit.

Realizing that filtration of Chicago's water supply must come as a public health measure, and with appreciation of the fact that the science of water purification was still in a developmental stage, the City Council authorized the expenditure of $50,000 on special research on filtration practice. Responsibility for carrying out these studies was placed in a Division of Water Safety Control then existing as part of the Bureau of Engineering.

Research work gets underway

The now famous Chicago experimental filtration plant was put into operation in April 1928. This plant has served two valuable purposes: First, it demonstrated to the public what filtration could do to improve the raw lake water and thus served to persuade citizens to support filtration; and second, it provided the means for investigating the most effective and economical methods and equipment for treating Lake Michigan water at Chicago. Expectations in both instances have been realized and the investment in the experimental plant has been well justified. Design of the plant now under construction was based largely on the results of this research work.



Water supply facilities in Chicago. Shaded area will be served with treated water from the South District plant.

During the period 1931 to 1938, studies in connection with South District Filtration Project were made by a staff of designing engineers assigned to the Water Purification Division. Their work included an investigation of inland and lake front sites, layouts of the filtration plant and economic sizing of the related structures such as intake works, lowlift pumping facilities, mixing and settling basins, chemical building, filters and filter building, filtered water reservoir and outlet works, breakwater, plant cofferdam, hydraulic advantages to be derived from connecting the filtration plant to the existing south side tunnel system, economics of filtration with universal metering and with partial metering under present ordinances, and the arrangement of the lake front park and bathing beach adjacent to the plant.

Final decisions resulted in the location of the 320 mgd. filtration plant within a cofferdam enclosing about 38 acres built in the lake north of 79th St., and the use of a direct intake protected by a breakwater. The final plan also included a 110-acre lake front park extending from 75th St. to 79th St., and a bathing beach having a frontage of about 3,000 ft., installation of 13,235 ft. of 16-ft. dia. tunnels and 1,233 ft. of 13 ft. and 140 ft. of 9-ft. dia. connecting tunnels. The tunnels are necessary to bring Dunne Crib water through a connection to the present 14-ft. dia. lake tunnel to the plant and to convey filtered water from the plant back to the Southwest Land tunnel system to supply the three South District pumping stations.

Special enabling legislation, secured in July 1935, was required to finance the cost of construction and to obtain permission to build the plant on the lake shore.

There were objections to the lake front location of this plant. Because the city will need two more lake front sites for future filtration plants to serve the Central and North districts, special consideration, therefore, was given in the layout, to architectural design and landscaping of the park and filter plant area. Every effort has been made to develop a project that will be in harmony with, and a definite contribution to, Chicago's lake front beautification program.

Aided with federal money

After five years negotiations with the federal government the City Council received and accepted on Aug. 3, 1938, an offer of a grant-in-aid through the Federal Emergency Administration of Public Works on this project amounting to $5,415,750. In 1941, an additional allotment of $427,950 was made, thus making a total grant of $5,843,700.

While the estimated total cost of the treatment works combined with the installation of meters was $20,935,000, the original grant allowed was only on 45 percent of $12,035,000, the estimated cost of that part of the plant that could be completed within the time limit provided under federal law governing PWA gra

Work was commenced on the fil tion project in October, 1938. As June 1, 1942, the status of the work which does not include metering was as follows:

Contracts completed	$11,690,
Contracts underway	678,
Bids taken, but no contracts awarded	3,029,
Bids still to be taken	6,578,
Estimated total cost	$21,976,

Effect of the war

Because of the large quan tities of critical war mate rials involved in completin the filtration project, the city has not as yet been given a project preference rating from the War Production Board on the entire project. On March 10 of this year, however, the city did receive an A-2 rating for the completion of that part of the project bearing on the use of the direct plant intake, the bypass under the plant and the filtered water storage reservoir. These elements can be used to furnish an emergency supply of water to the South District in case of damage to the Dunne Crib or the present lake tunnel from this crib.

Before this auxiliary supply can be used, however, the direct intake, an emergency chlorinating plant and about 4,230 ft. of 16, 13 and 10-ft. dia. tunnels must be built to connect the discharge tunnel from the filtered water reservoir to the Southwest Land tunnel system. Because of favorable hydraulic conditions, the use of this direct intake and the connecting tunnels would increase the capacity of the south side water tunnels from 485 to 575 mgd. As the South District comprises the area where many of Chicago's larger war industries are located, the demands for water are unusually high. Therefore, this additional capacity will be needed.

In solving the numerous public health structural, hydraulic, financial, legal and civic planning problems that have arisen in connection with this project, Chicago has performed a notable service to its citizens and has made an important contribution to engineering knowledge.

Design: Problems and Solutions

Chicago's South District filtration plant has been designed to improve water service in three important aspects — quality, capacity and dependability.

Filtration and allied processing of the lake water will assure a safe and palatable water at all times. Low-lift pumping will provide gravity flow through the plant, which will permit maintaining the elevation of the filtered water at the outlet works from the storage reservoir normally at El. 3.0. As a result, the hydraulic gradient in the existing Southwest Land tunnel system will be raised, increasing the effective capacity of this system.

Essential first steps in the design of the project were decisions relating to size, scope of treatment, adaptation to existing facilities, and cost. Each of these considerations, in turn, was complicated by a host of problems involving hydraulic functions, structural arrangements and architectural treatment. This three-part article outlines major problems and their solutions.

Hydraulic Functions

In Determining the plant size, consideration was given to future water demands in the South District. Present design is predicated on supplying filtered water to consumers in the districts served by the 68th St., Western Ave., and Roseland pumping stations of the city, and a small station operated during the summer by the Chicago Park Board. Population forecasts and estimates of pumpage shown in the accompanying tabulation were used.

Principal factor that determined the size of the plant to meet these estimated demands was the limiting rate of filtration of Lake Michigan water at Chicago during summer and winter conditions. These rates were established following years of experimental work. They are as follows:

Seasonal conditions	Gal. per sq. ft. per minute for continuous operations up to:		
	6 hr.	*16 hr.*	*24 hr.*
Normal weather....	4.0	4.0	3.5
Cold weather......	3.0	2.75	2.5
Hot weather.......	4.0	4.0	3.5

It was assumed that these high rates could be maintained if necessary, within the given limits of time; and also that 10 percent of the filter area might be out of service at any period. On this basis the net output of the 80 filters that may be maintained for any 24-hr. period is 504 mgd. in summer and 360 mgd. in winter.

Subject to a 6-hr. limitation, the maximum rate of delivery of water from the filters would be 576 mgd. in summer and 432 mgd. in winter. The limiting factor that determines the theoretical service period for this plant, therefore, is the winter demand.

It is estimated that the initial 80 filters will be adequate to meet all reasonable demands for water in the South District under a complete metering program until 1965.

The 1941 pumpage rates at three South District pumping stations under a partially metered system were:

Average daily pumpage	318.1 mgd.
Max. — 24 hr. (hot weather)	429.3 mgd.
Max. — 24 hr. (cold weather)	312 mgd.

It is obvious that unless a water conservation program is put into effect in the South District before the filtration plant is completed it will be necessary to operate it at almost capacity rates.

Because of the acute shortage of tunnel capacity in the South District, special efforts were made to obtain every possible hydraulic advantage that the filtration plant offered to increase the effective service capacity of these tunnels. The elevation of the street surfaces in the vicinity of shafts in the present Southwest Land tunnel system limits the elevation at which the water can be maintained at the outlet works of the filtered water reservoir to about El. 5.0. It is probable that under normal operation this water elevation will be maintained at about El. 3.0.

The problem of connecting the filtered water tunnel to the present Southwest Land tunnel involves several complications: (1) there must be no interruption of service while the lake water is shut off and filtered water supplied; (2) the shore shaft on the Southwest Land tunnel system is plugged (except for a small access opening) immediately above the crown of the tunnel and the removal of this plug would involve serious hazards; (3) the only gated stub connection (Yates Ave.) on the Southwest Land tunnel to which a connection could be made, without necessitating a shutdown of pumps, is only 9 ft. in diameter, and this was hydraulically inadequate; and (4) the city has under construction the new 10-ft. dia. Stewart Ave. tunnel to the Roseland pumping station.

Land connection tunnel

After due consideration of all of these factors and a study of three alternative schemes for connecting the 16-ft. dia. filtered water tunnel to the present 14-ft. Southwest Land tunnel, it was decided to make two connections to the existing land tunnel. One of these, of 9 ft. dia., is to the Yates Ave. stub; the other of 13 ft. dia. is to a 10-ft. dia. shaft in the 8-ft. Oglesby Ave. branch tunnel to the 68th St. pumping station. Through this branch filtered water can flow northward to the 68th St. pumping station and southward back to the Southwest Land tunnel, supplementing that delivered through the Yates Ave. stub.

At the present time, using the crib intakes (without the Stewart Ave.

tunnel) the capacity of the Southwest Land tunnel is about 485 mgd.

With the Stewart Ave. tunnel in service this capacity can be increased 37 mgd., to a total of 522 mgd. With the filtration plant in operation this capacity can be increased another 113 mgd., to a total of 635 mgd. These capacities are based on the following maximum rates of pumpage at the various stations:

Pumping station	Pumpage mgd.	Water level at station
68th St.........	210	– 9.0
Washington Park	10	——
Roseland	175	-17.75
Western Ave....	240	-22.1

Thus with the filter plant in operation (filtered water reservoir at El. 3.0) in conjunction with the Stewart Ave. tunnel the effective capacity of the South District tunnels will be increased 150 mgd. over present conditions.

Later, by the construction of about 15,500 ft. of 12-ft. dia. tunnel in 74th St., between Oglesby Ave. and State St. paralleling the present Southwest Land tunnel, the capacity of the South District land tunnels could be increased to 890 mgd. These capacities are based on the following maximum rates of pumpage at the various stations:

Pumping station	Pumpage mgd.	Water level at station
68th St.........	250	–12.2
Washington Park	10	——
Roseland	250	–15.6
Western Ave....	240	–24.85

Tunnel connections

The filtration plant will be supplied with lake water from two sources, the direct intake at the east end of the plant and the Dunne Crib intake that now supplies the South District. Water from the latter source will travel through 10,670 ft. of 14-ft. dia. tunnel and 6,200 ft. of new 16-ft. dia. tunnel. The loss-of-head in flow from the crib to the intake will be 3.6 ft. at a 320-mgd. pumpage rate, 8.0 ft. at a 480-mgd. rate, and 14.1 ft. at a 640-mgd. rate.

Since water from either intake will be satisfactory, depending on the treatment provided, it is to be expected that for purposes of economy the direct intake will be used a large percentage of the time. When the plant is first put into operation the direct intake will be used while the connection is made between the new raw water supply tunnel to the plant and the present lake tunnel that will have been dewatered. Before this dewatering can be done, however, a bulkhead will be placed in the lake tunnel east of the short shaft. This will be done as soon as the filter plant is put into service to supply the Southwest Land tunnel system.

Providing two intakes for the plant gives protection against ice difficulties in winter and provides a secondary source of supply in case of damage to either of them. It will be possible to use both sources simultaneously; indeed, this may be normal practice during extreme winter weather.

When only the direct plant intake is used with all 34 ports open, the velocity of flow through them would be as follows at the pumpage r indicated.

Pumpage	Intake flow vel
320 mgd................	0.30 ft. per
480 mgd................	0.45 ft. per
640 mgd................	0.60 ft. per

How the plant works

Water will be pumped under a he of approximately 18 ft. above la level into the raw water conduit Flow through the plant will be b gravity. (See flowsheet insert follow ing p. 120.) Leaving the raw wate conduits the water will be directe through three flow units—each o which includes a venturi meter, a chemical application channel, a baf-

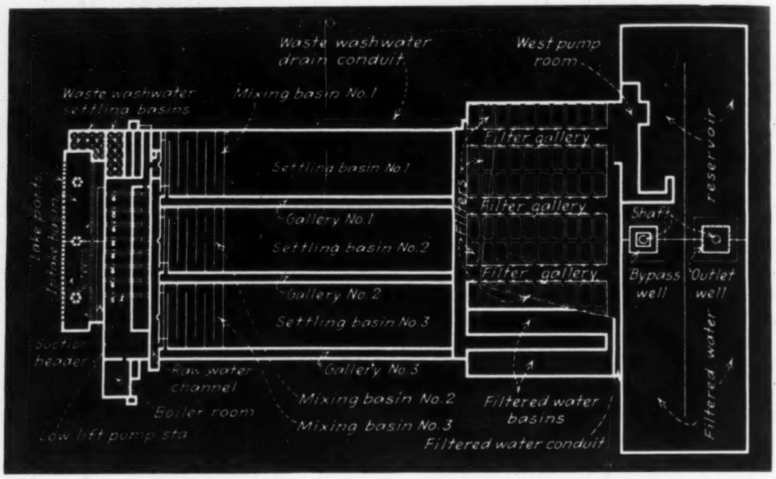

Waste washwater
drain conduit
West pump
room
Waste washwater
settling basins
Mixing basin No. 1
Filter gallery
Settling basin No. 1
Lake ports
Intake basin
Filters
Filter gallery
reservoir
Shaft
Gallery No. 1
Settling basin No. 2
Filter gallery
Bypass
well
Outlet
well
Gallery No. 2
Settling basin No. 3
Suction
header
Raw water
channel
Gallery No. 3
Filtered water
Boiler room
Mixing basin No. 2
Mixing basin No. 3
Filtered water
basins
Low lift pump sta
Filtered water conduit

Fig. 1. General layout plan showing the direct water intake, the pumping station and the treatment units. Flow is subdivided among three identical processing units.

POPULATION AND PUMPAGE ESTIMATES

Estimated Population in South District

Year	City	Suburbs	Total
1940.............	1,200,000	25,000	1,275,000
1950.....	1,420,000	130,000	1,550,000
1960.............	1,600,000	170,000	1,770,000

Estimated Pumpage in South District (M G D Units)

	1950			1960		
	City	Suburbs*	Total	City	Suburbs*	Total
Average day-year.......	228	24	252	257	35	292
Normal weather						
Max.	343	24	367	387	35	422
Aver.	223	24	247	252	35	287
Min.	102	24	126	115	35	150
Cold weather						
Max.	334	30	364	376	44	420
Aver.	291	30	321	272	44	316
Min.	214	30	244	127	44	171
Hot weather						
Max.	425	30	455	479	44	523
Aver.	284	30	314	320	44	364
Min.	142	30	172	160	44	204

*Pumpage to suburbs based on uniform supply in conjunction with the use of storage reservoirs.

Assumed per capita daily consumption of water in 1960

	City			City plus suburbs		
	Max.	Aver.	Min.	Max.	Aver.	Min.
Normal weather................	242	157	72	239	162	85
Cold weather....................	235	170	80	238	179	97
Hot weather.....................	300	200	100	296	206	115

Principal Plant Units

- A double water intake basin
- Low-lift pumping station of 600 mgd. capacity
- Two raw water conduits
- Three 60-in. venturi meters
- Three chemical application channels with rapid rotating paddles
- Three baffled mixing channels
- Three two-story settling basins partly equipped with sediment removers
- Three carbon - dioxide application chambers
- 80 rapid-sand filters
- Eight filtered water basins beneath the filters
- Two main filtered water storage reservoirs
- Raw water bypass
- Chemical building with storage and handling facilities
- Washwater pumps and tanks
- Administration building, laboratories and shops
- Waste washwater settling tanks
- Sediment pumping equipment

fled channel, a mixing and a settling basin.

Most of the chemicals will be added in an application channel equipped with mechanical agitators to insure rapid distribution. A baffled channel, providing additional rapid mixing, will be fitted with baffles so constructed as to produce a nearly uniform forward velocity from top to bottom of the channel. The water will be split into two flows at the outlet of this channel.

The flow will be about equally distributed through the lower and upper stories of the mixing and settling basins. Elevation of the water in the mixing and settling basins will be about 15.5 ft. above average lake level. At rated capacity the mixing period will be about 52 min., and the settling period will be about 3.7 hr.

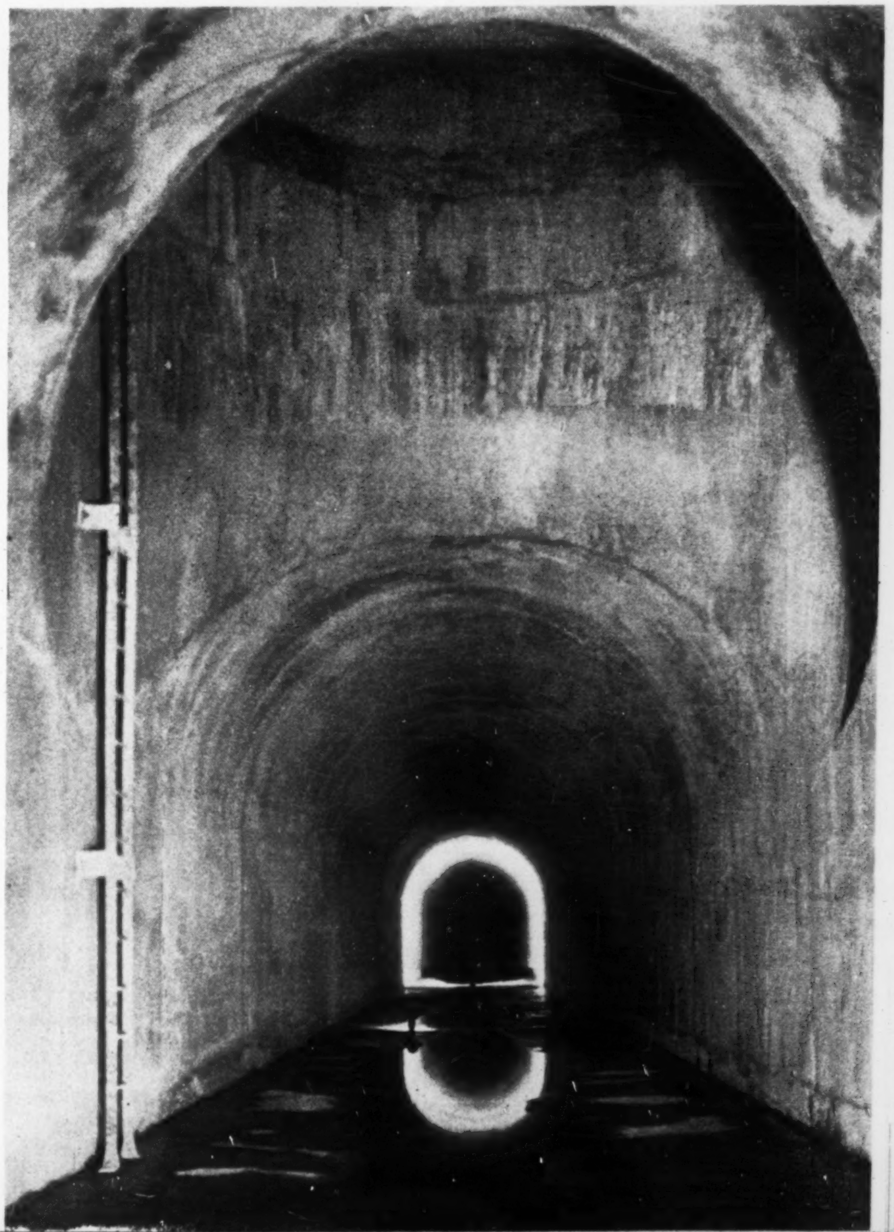
At the outlet of the mixing basins the water will pass through slotted walls to the two-story settling basins. One-third of the area of each settling basin is to be provided with continuous sediment-removal equipment; the remaining two-thirds will receive periodic sludge removal.

From the two-story settling basins, the water will pass through carbon-dioxide chambers, then to a settled water header with laterals extending through the filter galleries. It is not likely that there will be complete mixing in the settled water header, for the flow passing through the north settling basins will go largely to the filters on that side of the plant, and that passing through the south settling basin will go largely to the filters on the southerly side.

After passing through the filters the water is to be collected in small water basins located immediately under the eight banks of filters. A water header connects these basins with the two main filtered water storage reservoirs. Usually the water level on the filters will be maintained between 14.5 and 15.5 above average lake level. The water in the filtered water reservoirs, under normal operation, will vary between 1 and 4 ft. above lake level and may be maintained much of the time at 3 ft. above datum. Loss-of-head through the filters, therefore, will vary from 12 to 15 ft. Filtered water storage reservoirs, however, may be drawn down lower at times.

The outlet chamber is built on the center line of the filtered water storage reservoirs, and connects the reservoirs with the outlet shaft. The raw water bypass shaft also is located on the center line of the storage reservoirs about 140 ft. from the filtered water outlet shaft. It is surrounded by a dry area which, under normal operation, will be maintained dry. To use the raw water bypass, gates in the bypass shaft and the wall around the dry area will be opened and the water will flow from the shaft into one or both of the filtered water storage reservoirs. Bypass water may be obtained from the Dunne Crib or from the direct plant intake.

Fig. 2. Filtration plant tunnel at the point where connection is made with a transition shaft. Size and location of tunnels called for careful study in order to provide maximum hydraulic advantages.



During operation of the plant the three flows of water will be so divided that each flow unit will receive approximately the same periods of mixing and settling. The plant is being so constructed that the water level in the mixing and settling basins may be lowered to an elevation of about 11 ft. above lake level with the plant still in operation. Being able to lower the water level in these basins from 4 to 5 ft. provides emergency storage in case of power failure in the low-lift pumping station.

As the water area in the mixing basins, settling basins, and above the filter beds prior to filtration is about 418,600 sq.ft., a storage capacity of about 3.13 million gallons per foot of depth is provided. A draw-down of 5 ft. in these basins and conduits represents about 15.65 mg., or 70 min. storage at the 320 mgd. rate. With a draw-down of 10 ft. in the filtered water reservoir there is storage of about one hour and fifty minutes at the same rate. This provides a total available emergency storage of about three hours, which is believed to be ample for most needs.

Structural Arrangements

Principal Items for discussion under structural arrangements include the breakwater, a huge cofferdam, design assumptions, expansion and contraction provisions, rock anchorage and concrete placing. These are outlined in the following.

Breakwater — First item of construction to be placed under contract was the breakwater, a structure serving several purposes. During construction it protected the cofferdam against the destructive forces of northeast lake storms. When the plant is in operation, the breakwater provides a stilling basin for the inshore plant intake. During the winter it is expected that the basin will be covered with sheet ice and this will lessen the hazards of frazil ice formation at the intake. It will also give protection to the intake against mass sheet-ice formation.

The breakwater is a rubble, mound structure about 2,660 ft. in length, built in the shape of a flat, inverted V, the apex of which is 1,000 ft. east of the east face of the substructure. Built in water of 22-ft. depth, it rises to 6.5 ft. above normal lake level. The mound rests on a layer of sand and clay that overlies the bedrock; the latter is very close to the lake bed for about one-half the length of the breakwater.

Cofferdam—To carry on substructure construction in the dry, a cofferdam was built to enclose the entire area in the lake within which the initial and future filter plant units were to be excavated and constructe

This cofferdam was 1,600 ft. lo east and west, 1,050 ft. wide nor and south, and enclosed slightly mo than 38 acres. The dam consisted o a clay core faced with riprap on th inside and with large stone on th outside and top. A single row of interlocking steel sheet piling wa driven through the clay core to bedrock.

The top of the cofferdam is at El. 10 and the average depth of water is 18 ft. After completion of the cofferdam, the water in the area enclosed by it was pumped out in seven days, using three 16-in. and three 6-in. centrifugal pumps; more than 172,000,000 gallons of water were removed. After dewatering, seepage was about 100 gpm., which required only one 6-in. pump operating 5 min. each hour to keep down the water.

Substructure—The entire substructure was built of reinforced concrete. Studies indicated that flat slab floors of 20-ft. span would be the least expensive construction, and this design fitted admirably the requirements of the various channels needed for the flow of the water. Tied columns were found more economical than spiral columns and were used throughout, except in a few places where space limitations required use of small spiral columns. Rods of ¼-in. dia. wound in spirals with 6-in. pitch were used as ties for all tied columns, whether square or round.

Superstructures — Designs have been completed for the superstructure buildings which, with the exception of the chemical building, are to be of steel skeleton construction with brick or stone walls and reinforced-concrete floor slabs. In most cases the roofs will be constructed of precast concrete channel slabs. Quarry tile will be used for floor finish in areas open to the public; terrazzo and rubber tile are planned for lobbies and offices. The shops probably will have wood block floors.

The structural frame for the chemical building, including the storage bins for the dry chemicals, has been designed to use reinforced concrete.

Design considerations

Design assumptions and computations were made to comply with the requirements of the Chicago Building Code. The following unit stresses were used: Structural steel—18,000

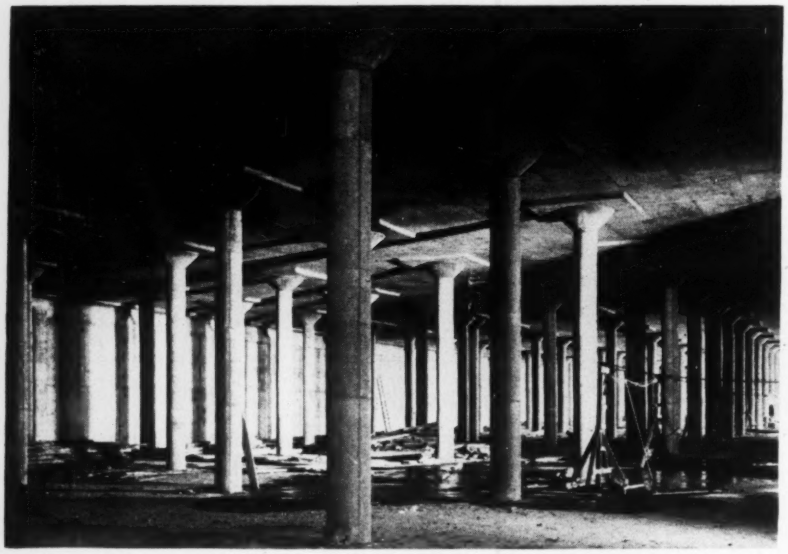


Fig. 3. Portion of the clearwater reservoir in the west substructure. Two reservoirs, with a combined capacity of 36 million gallons, have been provided for the storage of filtered water.

psi.; reinforcing steel—20,000 psi.

Concrete was designed for an ultimate compressive strength of 3,000 psi. after 28 days. Material tests were in accordance with A.S.T.M. specifications. Concrete was made with standard portland cement combined with sand and gravel aggregates. Coarse aggregate in the mix was limited by weight to not less than one-half nor more than two-thirds of the total weight of combined fine and coarse aggregate.

Concrete requirements were as follows:

Cement per cu.yd. of concrete, 6 to 6½ cu.ft.

Water per cu.ft. of cement, 6 gal.

Cylinder crushing strength, 28 days, 3,750 psi.

Concrete test cylinders averaged 4,300 psi., only a few being as low as 3,000 psi. Some were as high as 6,000 psi.

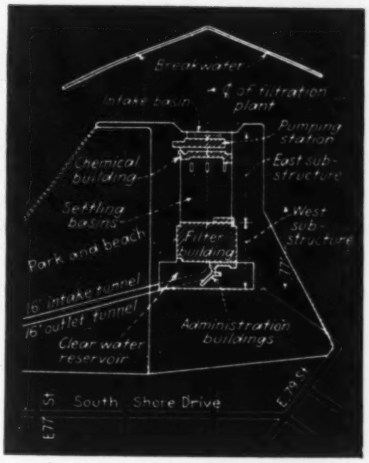

Breakwater
℄ of filtration plant
Intake basin
Pumping station
Chemical building
East substructure
Settling basins
West substructure
Park and beach
Filter building
77'
16' intake tunnel
16' outlet tunnel
Clear water reservoir
Administration buildings
E 77 St
South Shore Drive
E 79 St

Fig. 4. Relationship of the breakwater, principal plant structures and tunnel connections at the lake shore site.

Slabs were designed for a superimposed load varying from 100 lb. per sq.ft. in areas where no special loads occurred, to 2,060 lb. per sq.ft. in the settling basins. Slabs forming the roofs over settling basins and clear water reservoirs were designed for 550 lb. per sq.ft. of earthfill and live load. In all areas the bottom slabs were designed for upward hydrostatic pressure due to groundwater.

Walls were designed for horizontal pressure exerted by water in the basins, and by earthfill. Since water pressure might be exerted on either side, most of the walls were double reinforced. Temperature reinforcing amounting to $p = 0.0025$ was provided for concrete in dry areas. For concrete that would be wet on one or both sides, the value for p was increased to 0.004.

Expansion joint provisions

In order to minimize cracks and because of its large size, the substructure was divided by expansion joints into units about 160 ft. square. In most cases the units were completely separated by joints that extended from bedrock to the top of the structure. Double walls were provided at these joints in the filter area; in many places double columns were used.

Brackets and ledges were added to some columns and walls to furnish sliding supports. For each beam requiring sliding support, two steel plates were anchored to the concrete, separated by a sheet of compressed graphite. The tops of the ledges sup-

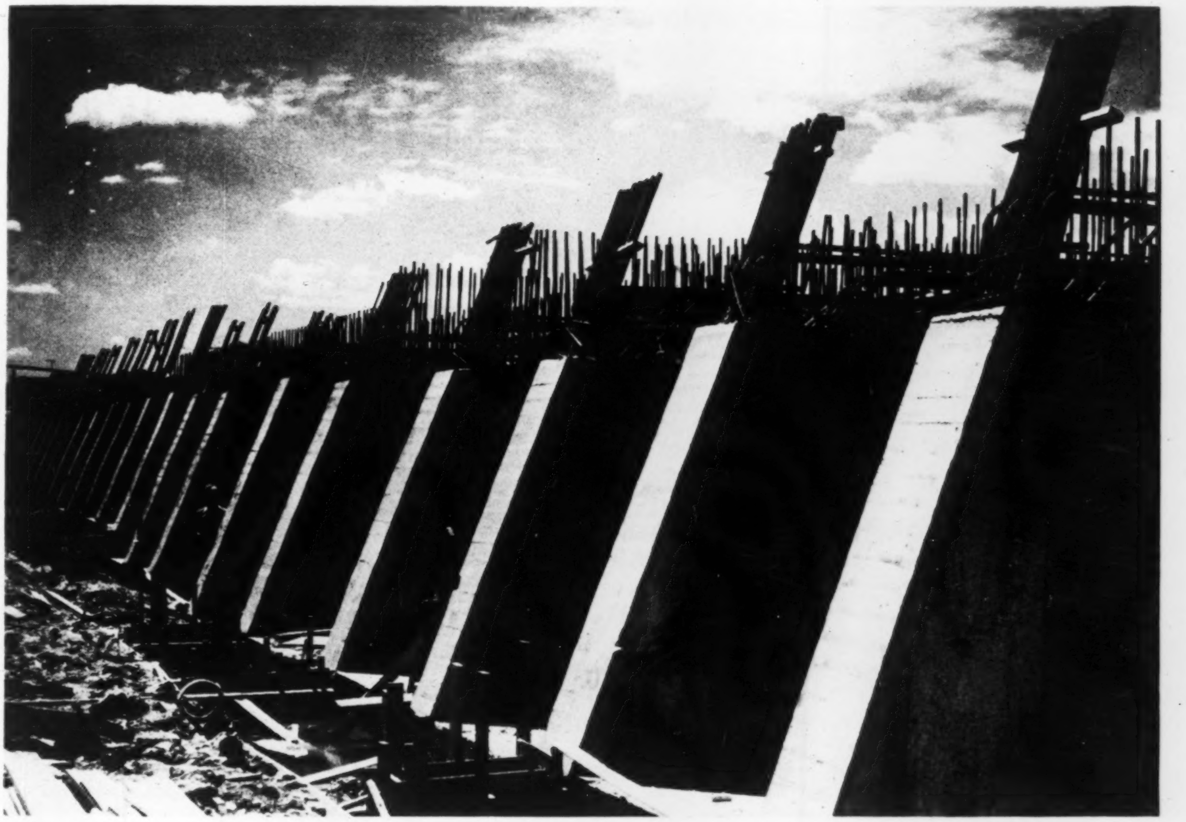


Fig. 5. Counterfort wall construction on the east substructure. Most of the walls extend down to bedrock but the floors are supported largely on piers in this part of the plant; the piers were anchored to rock to counteract uplift.

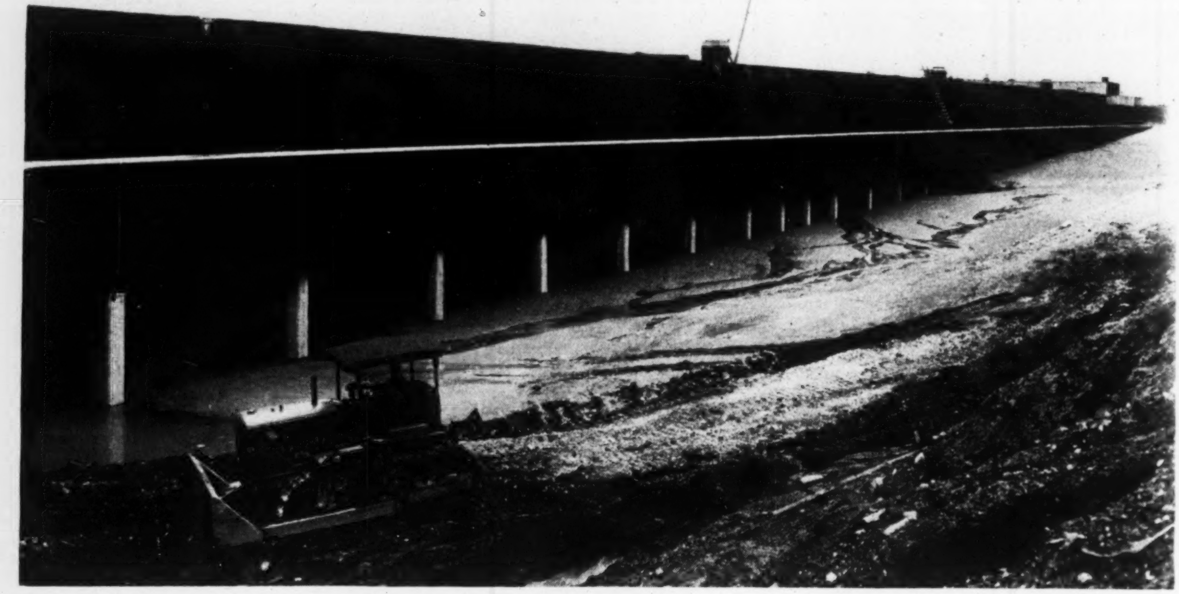


Fig. 6. Backfilling around the south wall of the plant. Extending the length of the wall is a box conduit for waste washwater drainage; the conduit is designed to resist hydrostatic pressure either from within or from the outside.

porting slabs were troweled smooth to provide sliding surfaces, then coated with graphite lubricant to reduce friction and lessen spalling.

In the settling basins, the sliding surfaces for the flat slabs were formed at the top of the column capitals. To provide against uplift in the bottom slab at expansion joints, anchor bolts of 2½ in. dia. were installed. These bolts were encased in 5-in. pipes, cut at the sliding surface. The space around each bolt was filled with mastic to permit movement of the bolt in the pipe. Plates 12x12x1½ in. were embedded near each end of the bolt to secure it in the concrete.

At the expansion joints premoulded sponge-rubber filler, 1-in. thick, was anchored to the concrete on one side of the joint by copper nails 3 in. long. Where it was desired to prevent passage of water through a joint, a continuous copper dam with a V bend in the joint was installed. Use of premoulded filler above the copper dams was omitted in floor and roof slabs, and the space was filled with poured mastic.

Uplift and horizontal pressures

Since the elevation of nearly all the lowest floor area is above the rock level, full uplift may occur. With the reservoirs empty, the weight of the structure would not be sufficient to counteract this uplift. Accordingly, the piers and some of the walls were anchored to the rock. The size and number of anchor rods were based on the amount of uplift.

After a portion of the rock was uncovered, tests were made to determine the holding power of rods grouted in the rock. Holes of 3½-in. dia., 6 to 8 ft. deep, were drilled in the rock. Because of the cold weather the rock was warmed with steam and any water in the hole blown out by compressed air. The hole was filled immediately with 1:2 cement mortar, the sand and water being heated before mixing. Anchor rods then were forced down into the hole, causing excess mortar to form a small mound around the rods.

Each test was made on four holes in the corners of a 2½-ft. square, with two 1⅛-in. square deformed rods in each hole. The rods were spot-welded on 30-in. centers and had a crosshead made of plates at the top to react against the beams. The test beams were eight 24-in. 100-lb. I-beams, 22 ft. long, and arranged in pairs. Supports for the beams or backs were at least ten feet away from the rods to be tested. The required test load for each two-rod anchor was 70,000 lb.

Quantities in Substructure

Earth excavation	575,000	cu. yd.
Reinforced concrete	220,000	cu. yd.
Reinforcing steel	22,000	tons
Structural and Misc. Iron	423	tons
C. I. Pipe and Fittings	700	tons
Sheet Copper for Dams	65	tons

There were no failures of the rock, nor were any failures of the rods in tension or bond revealed by the tests. In fact, on one test the pull was increased to 194,000 lb. on each anchor without any signs of failure. This pull which could not be maintained due to stretching of the rods, correspond to a tension stress of 77,000 psi. As a result of the tests, it was decided to grout all anchor rods 6 ft. deep in good rock.

Free-standing retaining walls

The south wall of the south settling and mixing basin, and all the galleries, were designed as free-standing retaining walls. For the south wall, counterforts were provided, the base width of which depended on the depth to bedrock. Galleries were designed as rigid frames capable of resisting water pressure from either side of the gallery. At the east end of the south mixing and settling basin the horizontal pressure is carried down to rock through vertical concrete trusses. At the west end of the settling basins this pressure is carried to the side walls by diagonal rods placed in the roof and the floor slab sections.

The top of each filter wall widens out to form a walkway that acts as a girder strengthening the wall against horizontal pressure. Earth pressure on the outside filter walls is transmitted by diagonal struts that extend from the walls at the floor level of the filters to the base of the first row of columns in the filtered water basins underneath.

Except at the outlet and bypass shafts the filtered water reservoirs are separated by a common dividing wall that spreads into a heavy beam at its top. This wall is fixed at the floor slab of the reservoir. The outside reservoir walls are cantilever-type, designed to resist water pressure from the inside and earth pressure from the outside. Roof slabs rest on the reservoir walls with sliding joints provided along the walls. The bases for the outside walls are 16½ ft. wide and are separated from the floor slab construction by means of expansion joints.

Walls rest on piers

Columns and walls in the west substructure are supported on concrete piers that rest on bedrock. While most of the walls in the east substructure extend down to bedrock, the floors are supported largely on piers. Sand and clay forming the lake bed was excavated over the entire area covered by the substructure. The surface of the rock varied from El. minus 16 at the northwest corner of the reservoir, to El. minus 39 along the north wall of the settling basins. The large, open space below all the basins permitted visual inspection during the water-tightness tests.

Concrete for the substructure was placed with four pumps. General contractor, Michael Pontarelli & Sons, used two double-action and two single-action units for this purpose. Piping of 8-in. dia. was used with the double-action pumps and 7-in. piping was employed on the single-action units; longest run of pipe was 1,700 ft. To facilitate proper handling of the concrete through the discharge pipes the slump of 6 in. originally specified was reduced to about 2 in.

Concrete was supplied from a central mix plant erected at the site and equipped with six 1-cu.yd. mixers; trucks carried the concrete from the mixing plant to the pumps. Biggest pour in a 24-hr. period was 2,600 cu.yd.; largest single pour was 2,500 cu.yd.

The roofs of the reservoir, the settling basins, and the intake basins eventually will be covered with 3½ ft. of earth. Therefore, the tops of these slabs were waterproofed using a 5-ply membrane laid in pitch; the center layer of the membrane is fabric and the other four layers are of felt. Coated with a heavy layer of pitch the membrane is protected against abrasion by a one-inch layer of tar concrete. Over areas which were to be covered by superstructures the membrane and tar concrete were omitted.

Architectural Features

Water treatment is a modern, scientific process and it was desired, therefore, that the architecture of the South District plant be as modern as the process used. The best thought today indicates a trend toward integration of design, structure and equipment with the architecture. A building should not serve merely as a skin surface or envelope. Its architecture should be planned to live. The architecture of this plant grew out of conditions peculiar to this location. It was not based on copy book styling. To fit the environment, and to make economical, yet beautiful use of today's structural and mechanical knowledge, the design of this project had to be creative.

The four large buildings—low-lift pumping station, chemical building, filter housing and administration building—have distinct functions. The first two are separated only by a roadway. Thus it was necessary to treat these two buildings to show their relationship, and they lent themselves admirably to a majestic composition.

Rhythmic treatment distinguishes the facade of the low-lift pumping station. Windows have been designed planularly to lead the eye to the entrance and dominant stack tower. No cornice motive or ornamentation is used. Sculpture is used in the form of bas-relief over the entrance door together with a free-standing sculptured figure serving as a counterpoint to the composition. The texture of the walls, obtained by a deep shot finish to the stone, laid in a modular system, gives a crisp, clean appearance.

The chemical building has a long continuous band of windows that serve to light the operating floor and enable one to see the intricate equipment within. Chemical storage bins above, with their large capacity, need no fenestration. Three large chemical pneumatic receivers are housed in a penthouse grouping which rises some 75 ft. above grade level. A control laboratory and lobby are housed in two small buildings that flank this large mass, thus producing a calm and imposing group. Terrace walls tie these two buildings into a sweeping composition, augmented by changes in grade levels. This gives powerful perspective vistas from numerous angles.

Tank is composition pivot

The administration and filter buildings form the second unified group, separated from the first by a grassed and terraced settling basin. Dominant feature is the washwater tank tower. It is the pivot of the mass composition and the transition point between the large neutral mass of the filter building and the smaller administration building. Offices are designed in free forms; planular treatment is used. This is best exemplified by treatment of the fenestration—windows go from wall plane to wall plane and from sill height to ceiling.

Interiors are of terra cotta and salt glazed tile, giving a dominant, clean and crisp motif of health cleanliness. Some conditions bring exterior stone into the interior surfaces of lobbies, and this produces an open and spacial feeling.

Exposed structural forms, such as columns and rigid bent roof frames, have been treated for honesty of construction that is carried throughout the project. The design itself is beautiful, yet not over decorated. Light for the filter-operating plant galleries is obtained by means of clerestory lighting. To overcome condensation problems glass block is used for this condition.

Careful attention has been given to landscaping. The Carnegie-Illinois mills to the south will be screened somewhat by trees. A long-range landscape plan has been made, with proper consideration for recreational, park and bathing facilities. However, all of these things are subservient to the primary purpose of a rational housing to the functional modern water treatment plant. (See model on flowsheet insert following p. 120.)

Lifting Water from the Lake

Because Lake Michigan water varies in quality at different locations throughout the year, both inshore and offshore sources of supply are made available to the filter plant. Both sources may be used simultaneously, or either may be cut off, thus providing unusual flexibility with dependability of supply. Huge centrifugal pumps —four of 100 mgd. capacity and four of 50 mgd.—lift the water 18 ft. from the lake to provide gravity flow through the plant.

LAKE-SHORE LOCATION of the South District filtration project has made it possible to provide two independent and widely separated sources of supply. Water can be taken directly from the lake at the east end of the plant or from the 68th St. and the Dunne cribs through a tunnel connection to the existing tunnel system.

It is anticipated that at certain seasons of the year one source will furnish a more satisfactory raw water than the other. The ability, therefore, to switch quickly from inshore water to that from offshore permits an operating flexibility that should result in lower costs for chemical treatment.

Furthermore, the availability of two sources of supply will minimize the hazards of ice troubles in winter and will permit the use of the better of the two waters should it be necessary during an emergency to bypass the filter plant and introduce chlorinated raw water in the filtered water storage reservoir.

Flow of water through the plant is in a straight line from the intake basin at the eastern end to the filtered water reservoir and the outlet shaft at the western end. (See flow diagram insert following p. 120.) The direct intake is some 2,000 ft. out from the original lake shore at this point; the water here is about 24 ft. deep.

The new tunnel connection to the existing tunnel system will be made at 73rd St. This new tunnel—at an elevation some 135 ft. below lake level—extends southward to the longitudinal center line of the plant, intersecting this center line near the middle of the filtered water reservoir. At this point it turns easterly on the center line and extends to a point below the intake basin. Here a 16-ft. dia. uptake shaft rises to El. minus 70 where two branches, one north and the other south, connect with the two 12-ft. shafts that enter the north and south sections of the intake basin respectively. The bypass connection from the raw water inlet tunnel to the clearwell is a 16-ft. dia. shaft.

The intake basin extends across the front of the filtration plant and is divided by a cross wall into two equal parts. Three vertical shafts from the tunnel are located on the longitudinal center line of the basin, the middle shaft forming part of the cross wall. (Fig. 1 on p. 102.)

These vertical shafts extend to an elevation 10 ft. above lake level. Flow in each will discharge into the intake basin through six 5x5-ft. sluice gate openings. The bottom of each gate is just above the floor of the intake basin, which is 24 ft. below lake level. The middle shaft discharges into each half of the basin. Three of its gates are located on one side of the dividing wall and the other three on the opposite side.

Thirty-four lake ports, 6x8 ft. in size, are located in the east wall of the intake basin. The bottom of the ports is 20 ft. below lake level, and the ports can be closed by gates operated from above. It is probable that in operating the plant the gates on one side (18 of them) will be closed and those on the other side will be open. By this arrangement and proper adjustment of the gates on the middle uptake shaft from the tunnel, water can be drawn with little difficulty from either the crib intake or the direct plant intake.

Each of the 34 screens located between the intake basin and the pump suction header is 7x14 ft. high. Screens are of ⅜-in. mesh, and they are woven from .083-in. dia. wire. Positioned in vertical guides between concrete piers, the screens will be raised for cleaning or repair by means of an electric hoist, the trolley for which is hung from the roof of the screen room.

There are two sets of guide grooves in each pier, one on each side of the curtain wall. This permits placing a spare screen in position while the other is removed.

The pump suction header is a rectangular chamber 280 ft. long by 13 ft. wide. Parallel to the screens and the low-lift pump room, it is divided into halves by a continuation of the wall which separates the two parts of the intake basin. Sluice gates in the outer wall and dividing wall permit water to be taken from either or both halves of the intake basin. Since water may enter either half of the intake basin from either of the two sources of supply, it is possible to furnish water to one half of the pumping equipment from the lake ports while supplying the other half with water from the cribs. And it is possible also to supply all pumps with water from either source.

Low-lift pump arrangement

Eight low-lift pumps will be used, four with a capacity of 100 mgd. and the balance of 50 mgd. capacity. The pumps are all of the horizontal, single-stage double-suction type, each directly connected to a synchronous motor. They are arranged in one row with shafts end to end, and with larger and smaller units alternating. Located on a floor whose elevation is 5.5 ft. below Chicago datum (normal lake level), the center line of the pump connections to the suction header is 18.5 ft. below datum. The pumps discharge into the raw water conduit, whose overflow line is 19.5 ft. above datum.

Water level in the suction header varies with the lake level, the pumpage and the source of supply. Assuming the lake level at datum, the water

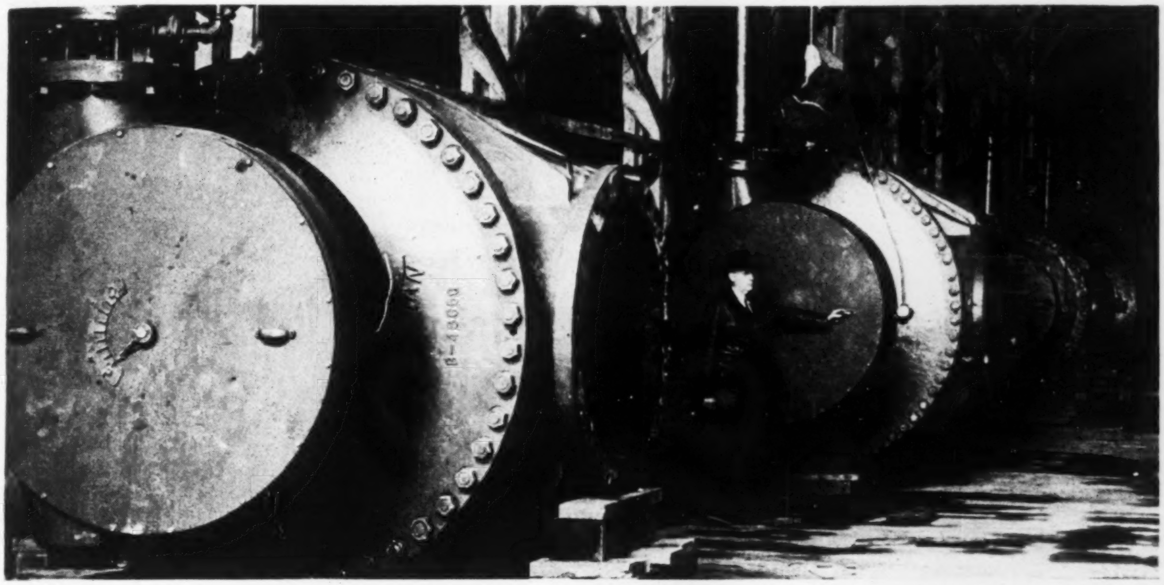


Fig. 1. Lining up two of the 36-in. and two of the 48-in. cone valves installed on the discharge end of the low-lift pumps.

level in the suction header will vary as follows:

Water through lake ports

Pumpage 250 mgd. — Water level — 0.2
Pumpage 450 mgd. — Water level — 0.3
Pumpage 550 mgd. — Water level — 0.5

Water from the tunnel

Pumpage 250 mgd. — Water level — 2.3
Pumpage 450 mgd. — Water level — 7.0
Pumpage 550 mgd. — Water level — 9.0

Monthly mean lake levels since 1860, as determined by the U. S. Lake Survey, have varied from a minimum of minus 1.7 (1926) to a maximum of plus 3.5 (1886). Records maintained by the Chicago Water Purification Division since 1927 show a monthly maximum of plus 2.2 (1929) and a monthly minimum of minus 2.6 (1934).

The head variations just described make it difficult to secure maximum pump efficiency at all times. Therefore, the pump design has been such that the efficiency curve is quite flat over a wide range. Over most of the range encountered, the brake-horsepower per million gallons pumped, will vary from 5.2 to 6.6.

Automatic valve control

Cone-type check valves are installed on each pump discharge. These valves operate automatically, closing the 36-in. valves on the smaller units in five seconds and the 48-in. valves on the larger units in six seconds. The time of closure can be adjusted.

Valve control is accomplished by means of a solenoid-operated four-way pilot valve, actuating a relay valve that admits water, under pressure, to the hydraulic cylinder operating the cone valve. Thus, when the motor reaches synchronous speed, the closing of the field switch in the pump motor circuit energizes the solenoid; this actuates the pilot valve and in turn the relay that causes the cone valve to open.

When the solenoid control is deenergized it reverses the action of the pilot and relay valves causing the cone valve to close. When the cone valve is 95 percent closed the circuit breaker on the pump motor is tripped by a limit switch on the cone valve, stopping the motor and pump.

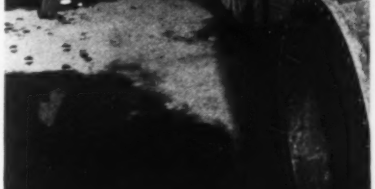


Fig. 2. Suction pipe for the pumps.

In each of the pump discharge pipelines, following the cone check valve, a venturi meter is installed. Following the venturi meter the discharge line splits into two branches —one branch leads to the upper raw water channel and the other to the lower raw water channel.

Electrically operated gate valves are located in the suction pipe of each pump and also in the discharge lines to each raw water conduit.

Power supply features

Electric power will be purchased. Even though this plant will supply water to one-third of Chicago, a complete standby plant was considered unnecessary because of the excellent record of service at the city's pumping stations. Records of power outages at electric pumping stations in Chicago since 1922 show that the longest time any station was down was 100 minutes on Mar. 17, 1924. In recent years power service has been progressively more reliable, and there has been no outage since April 29, 1934.

The filtration plant has been designed with a water storage capacity to last throughout a power outage of greater duration than heretofore has occurred in a pumping station.

Small turbo-generator sets located in the east and the west ends of the plant will furnish emergency power to a few small motors and lights that must operate at all times.

Water-Conditioning Processes

Research and its relation to plant design finds vivid demonstration in this water filtration project. Pilot plant trials of various treatment methods not only provided the information for precise determination of the facilities required to condition the water, but led further to the development of a new sodium silicate process. Use of the latter made it possible to adopt rates of filtration much higher than those normally employed, and this materially reduced the number and size of required filter beds at a great saving in capital expenditures.

SUCCESSFUL OPERATION of a filtration plant depends in large measure on proper chemical conditioning of the raw water. Many years of patient research revealed the special characteristics of Lake Michigan water and led to the development of processes that would produce the best results. What was learned and how this knowledge was applied in the design of conditioning facilities is told in the following.

First, however, it is in order to discuss briefly lake water characteristics. Except for occasional high peaks, the bacteriological content of Lake Michigan water in the vicinity of the intakes is low. Pollution enters the lake principally from sources in Indiana, including the Indiana Harbor Ship Canal and a lake front sewer at Whiting. Under the influence of winds from the south or southwest pollution is not infrequently carried out to the southerly crib intakes. Water to be taken from the offshore intake at the filtration plant also may be polluted from these sources. About one-half mile north of this intake there is a public bathing beach.

Turbidity of the lake water at the intakes usually is less than 15 ppm. and the water contains no color. Principal cause of high turbidity is the effect of wave action in bringing fine material from the lake bed into suspension. North to east winds are more responsible for periods of high turbidity than winds from other directions.

Lake Michigan water is moderately hard and has a pH value of about 8.0. The water is easily coagulated with any of the coagulants commonly used, although a high pH tends to retard rapid coagulation with alum.

Noticeable tastes and odors occur in the lake water a considerable portion of the time, but those that may be classified as very objectionable do not occur frequently. Industrial pollution produces some taste and odor, but the chief cause is microscopic organisms.

Summer Conditions—As a rule the water is not turbid during the summer months. Since plankton grow more rapidly when the water is clear, the absence of turbid water aids in their growth. In the early spring the algae rapidly begin to increase in number. Usually they reach a peak in May or June and decline in the summer; however, there may be another peak in the fall of the year.

Odors produced by microscopic organisms rarely occur until July, August and September. Then there may be a strong grassy to fishy odor over a period of from one to two months. *Dinobryan* and *Uroglenopsis* appear to be the organisms largely responsible for the fishy odor.

Winter Conditions—Cold water curtails the growth of microscopic organisms, following which the sediment at the bottom of the lake appears to be more easily broken up and mixed with the water. This is particularly true in the early part of the winter if there is a very strong northeast wind, the effect of which breaks up the film of slime at the bottom of the lake. As another film does not form readily, the fine sediment at the bottom then is picked up more easily by wave action.

When ice forms over the water along the shore line, pollution entering the lake is not readily diffused with the main body of water. Pollution concentrates in and under the ice near its point of discharge and later, when the ice is broken up, this highly polluted water may drift out to the lake intake in much higher concentration than otherwise would be the case.

In winter, therefore, the plant may have to treat water highly contaminated with sewage and industrial wastes for periods varying from a few hours to several days. At such times the water may contain very disagreeable tastes and odors. To meet these conditions the treatment processes must be adequate to handle highly polluted water.

Chemical treatment processes

It is planned to treat the water continuously with chlorine (or ammonia and chlorine) and a coagulant, And in order to assure a palatable water at all times, almost continuous use of activated carbon will be required. Alum, or one of the iron compounds, will be used to coagulate the water for clarification. Lime and acid-treated sodium silicate will be used at certain periods. When lime is used, sodium hexametaphosphate may be applied to the water to reduce the amount of carbon dioxide required. The lime and silicate treatments are for special purposes.

The type of coagulation produced by adding alum or one of the iron compounds to the water at Chicago may vary widely. Some, but by no means all, of the wide variation is caused by microscopic organisms. For reasons unknown there are periods in the winter months when coagulation produced by the commonly used coagulants is so weak that the floc breaks apart readily. Because the floc is so easily broken, passage of the water through filters does not remove all the coagulated matter. Temperature may be an influencing factor, but it is not the major cause, for there are winter periods when the coagulation produced is filtered from the water without difficulty.

Chicago experiences reveal that under conditions of weak coagulation, coagulated material may pass through the filter beds at 2 to 3-ft. loss-of-head. This occurs with sand of about 0.5 mm. dia., an effective size in beds 24 in. in depth, and with the filters operated at a rate of 2 gal. per sq. ft. per minute. Under these conditions the loss-of-head on the filters increases slowly and usually the rate of increase is not more than 0.1 ft. per hour. During periods when the coagulation is strongest, the loss-of-head may increase over 2 ft. per hour in the same filter and at the same rate of filtration.

These variations are so great that plant design alone cannot satisfactorily cope with them and at the same time make adequate provisions against their influence on the quality of the water produced. To obtain water of high quality under the condition of weak coagulation in winter, the filter sand grains would have to be much smaller in size than 0.5 mm. This would result in filter runs in summer much too short for the practical operation of a large plant.

Research has demonstrated that special conditioning of the water to aid the extreme condition that must be met at Chicago is the cheapest means of handling such conditions. Otherwise a much more costly plant than that planned for the South District would have been required.

Economic considerations

To determine the most economically balanced chemical treatment of water and plant capacity, consideration was given to treatment aids that would toughen the coagulated matter during periods when it otherwise would be weak and thereby make unnecessary the construction of large settling basins.

It was known, of course, that larger sand grains and faster rates of filtration might be used with tough, coagulated material without jeopardizing the quality of the water. Therefore, by toughening the coagulent, the size of the plant could be reduced, which, in turn, produces a saving in construction cost.

In the South District filtration plant the departure from customary practice in design and treatment has not been too radical. The initial three-unit plant is sufficiently large so that the maximum rate of filtration contemplated will not be required for many years. (Unless, however, there is delay in installing meters throughout the area to curb consumption.)

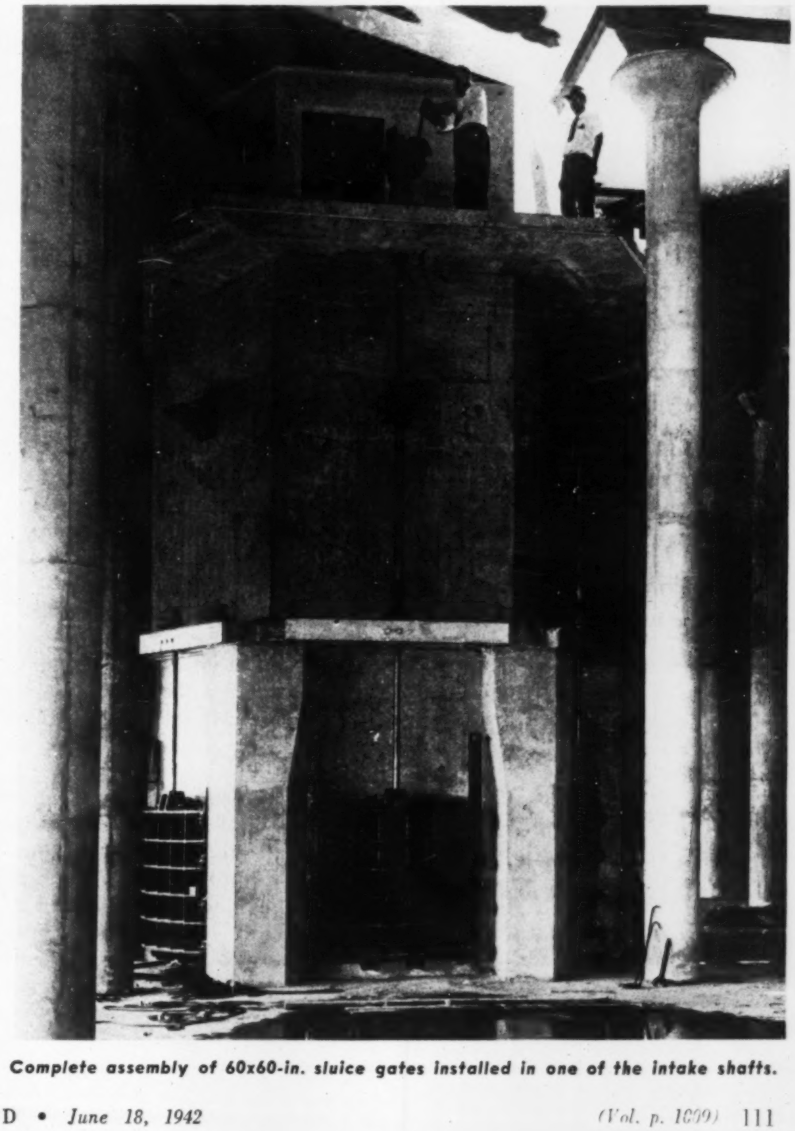
As the plant load increases, operating experience will determine whether it will be more economical to continue increasing the amounts of chemicals used to pretreat the water in order to produce satisfactory results with short settling periods and fast rates of filtration, or to increase the size of the plant.

Reasons for special treatments

In processing the water several special treatments will be employed. The following is a brief explanation of the function of these applications:

Lime Additions—Lime will be used mainly to produce better removal of the coagulated matter in the settling basins. Microscopic organisms occur in abundance in the clear lake water a large part of the time during spring, summer and fall. They have about the same specific gravity as the water, and their entrainment in the coagulated matter does not aid in rapid sedimentation. Coagulated matter with little entrained turbidity also is light and settles slowly.

The percentage of the coagulated matter that may be removed from the lake water at Chicago within three to four hours settling time frequently does not exceed 50 percent. When micro-organisms are abundant, more than 50 percent must be removed or rapid clogging of the filters will occur. Under these conditions with shorter filter runs, it would be difficult to keep the plant in efficient operation.



Complete assembly of 60x60-in. sluice gates installed in one of the intake shafts.

TABLE 1—EFFECT OF SILICATE ON COST OF COAGULATING LAKE MICHIGAN WATER

Turbidity Raw Water	Alum.		Silicate and Alum.				
			Silicate		Alum.		
	Parts per million	Cost per million gallons	Parts per million	Estimated cost per million gallons	Parts per million	Estimated cost per million gallons	Estimated total cost per million gallons
			Winter Months				
1	9.8	$ .88	1.67	$ .45	4.2	$ .37	$ .82
2	10.0	.90	1.72	.46	4.3	.38	.84
3	10.2	.91	1.76	.47	4.4	.39	.86
4	10.4	.93	1.89	.48	4.5	.40	.88
5	10.6	.95	1.84	.50	4.6	.41	.91
7	11.0	.98	1.91	.52	4.8	.43	.95
10	11.6	1.04	2.02	.54	5.0	.45	.99
15	12.6	1.13	2.18	.59	5.5	.49	1.08
20	13.5	1.21	2.33	.63	5.8	.52	1.15
30	15.2	1.36	2.61	.70	6.5	.58	1.28
			Summer Months				
1	5.2	.46	.93	.25	3.1	.28	.53
2	5.3	.47	.95	.26	3.2	.28	.54
3	5.4	.48	.97	.26	3.2	.29	.55
4	5.5	.49	.99	.27	3.3	.30	.57
5	5.6	.50	1.01	.27	3.4	.30	.57
7	5.8	.52	1.04	.28	3.5	.31	.59
10	6.1	.54	1.09	.29	3.6	.32	.61
15	6.5	.58	1.16	.31	3.9	.35	.66
20	6.8	.61	1.23	.33	4.1	.37	.70
30	7.5	.67	1.36	.36	4.5	.41	.77

TABLE 2—NUMBER AND SIZE OF BASINS, CHANNELS AND FILTERS

Type	Number	Horizontal dimensions (ft.)	Depth of water (ft.)	Area (sq. ft.)	Total capacity (m. g.)	Time
Raw water basin[a]	1	18 x 400	33	7,200	1.78	
Chemical application channels	3	9.5 x 120	14	1,140	.36	1.6 min.
Baffle channels	3	8.5 x 120	34	1,020	.77	3.5 min.
Mixing basins[a]	3	138 x 118	32	16,284	11.65	52 min.
Settling basins[a]	3	138 x 500	32	69,000	49.50	3.7 hr.
Sand filters	89	25.7 x 54	11.5	1,389		
Filtered water basins	8	53 x 320	16	17,000	15.00	1.1 hr.
Filtered water storage	2	280 x 450	19	126,000	36.00	2.7 hr.

[a] Two-story structures.

To aid in lengthening filter runs at some treatment plants, artificial turbidity has been added to water. However, where water is fairly hard the addition of small amounts of lime to cause a precipitate of calcium carbonate is a cheaper method of producing artificial turbidity. Calcium carbonate crystals so produced have a specific gravity in excess of 2.5 and a number of very small crystals incorporated in the coagulated masses add enough weight to cause them to settle raipdly. When lime is used in Lake Michigan water, there is no difficulty with two or three hours sedimentation in producing 90 to 95 percent removal of the microscopic organisms.

In addition to producing more rapid settling, the use of lime softens the water somewhat. This should result in lessening the soap requirements of the consumers. Figures on soap saving by softening are not available for Chicago, but there is belief that it will at least offset the cost of the lime treatment.

Sodium Silicate—This material when properly neutralized with acid, produces a substance that aids the coagulation of water when using alum or ferrous sulfate. Addition of a small amount of the silicate strengthens the coagulation and will cause it to be removed more easily by the filters. Therefore, during periods of weak coagulation it may be used to strengthen coagulation of the water. By using sodium silicate, sand coarser than that generally employed for filters will produce good results under the worst condition of the water.

Use of coarse sand in the filters will aid conditions in the summer months and lessen the amount of lime required for periods when the filter runs overwise would be short. In addition, faster rates of filtration may be used both in winter and summer. Use of the lime treatment part of the time in the summer to lengthen filter runs, and the silicate treatment part of the time in the winter to toughen the coagulated matter, results in the most economical treatment. The saving is not in chemicals required, however, but in the reduced initial capital expenditure for the smaller size plant required.

In Table 1 are given comparat costs of coagulating Lake Michi water at Chicago with alum al and in combinations with acid-trea sodium silicate. Without the use the silicate the water would not filt as clear as the silicate-treated wat but water equally satisfactory coul be obtained by using fine sand an slow rates of filtration. The data indicate almost equal chemical cos for the winter months, and a slightl higher cost for the treatment with silicate in the summer months.

Water of better quality will be produced in the winter months by use of the silicate treatment, even though coarser sand and fater rates of filtration are used. When the considerable savings in plant costs are taken into consideration the economy of using silicate is clearly indicated. From the standpoint of better quality of water alone, its use is justified.

Sediment returned to water

As lime is to be added to the water primarily to produce artificial turbidity to aid in hastening sedimentation, return of the precipitate from the settling basins to the raw water should lessen the amount of lime required. Provision will be made to permit on a trial basis the return of part of the sediment removed from the settling basins to the raw water. The first third of each settling basin is to be equipped for continuous sediment removal.

Sediment removed from the settling basins will be brought together in a small well located east of the settling basins and south of the low-lift pumping station and from here discharged into the lake. Should sediment return prove practical, then a portion of the sediment will be pumped to the chemical channels.

The number and size of the basins and reservoirs are given in Table 2. Based upon the customary rating of filters of 2 gal. per sq.ft. per minute, the mixing, settling, and filtered water-storage spaces are about the same as those prevailing in standard practice.

Based on experimental data it is believed that the plant can handle about 600 mgd. without difficulty. At this rate, the time of mixing would be about 28 min., settling about two hours, and the period of filtered water storage about two hours. These periods are short when compared with usual practice.

Features of the Rapid Sand Filters

Departures from standardized practice in the design of filters lend more than usual interest to the Chicago project. Among the features described are: Elevation of filters in relation to the settling basins to provide for reserve water storage in case of power outage; use of deep tanks to prevent air-binding; methods adopted for surge control; filter washing facilities; and hydraulic handling devices for sand and gravel.

A NUMBER OF SPECIAL FEATURES distinguish the rapid sand filters for Chicago, not the least of which is their design to permit high rates of filtration. In part the design reflects adaptation to meet particular needs, but in many instances entirely new concepts of practice have been introduced. The following description of filtration facilities points to departure from standard practice and the reasons why.

As a matter of general interest it should be noted that the filter building occupies a space about 365 x 577 ft. There are 80 filters, each of 4-mgd. capacity at a filtering rate of 2 gal. per sq.ft. per minute. Each filter has a surface area of 25.75 x 54 ft., or 1,391 sq.ft. The filter tanks are 13.5 ft. deep, which is deeper than the average filter of this type. A section through one of the pipe galleries and filters is shown in Fig. 1.

There are two reasons for constructing deep filter tanks. One is to lessen the negative head that will be produced at the maximum loss-of-head on the filter. Ordinarily, the lake water is saturated with air; therefore, any negative head within the filter beds might cause air to accumulate in the beds. The second reason for locating the beds low is to be able to draw down the water several feet in the settling basins and yet continue plant operation. This draw-down provision permits considerable storage of water in case of an emergency.

The filter manifolds are large and may be called semi-false filter bottoms. Object of this design was to produce uniform distribution of washwater from one end of the filter to the other, and to lessen the loss-of-head through this part of the underdrain system while washing.

Decision on the type of filter bottom has not been made, as certain critical materials are involved. The intention is to allow bids on several types, and select the cheapest bottom considered suitable for the conditions. It is probable, however, that the bottom selected will be either the concrete Wheeler-type, or the perforated pipe type. If the Wheeler bottom is used, the inverted pyramids will be located about 12 in. on centers. Perforated pipe, if used, will be spaced 12 in. on centers.

The washwater gutter extends the full 54 ft. length of each filter. Its width inside is 3 ft. 1 in. and it is 6 ft. 8 in. deep. The gutter is located along one side wall of each filter and does not divide the filter into two beds as is often the practice in the design of large filters.

There are advantages in having the filter bed all in one unit. With two beds connected to a single filter rate controller, there is no way of preventing the rate of filtration on one bed becoming greater than the rate on the other bed should there be even a slight difference in the size of porosity of the filtering material in the two beds. This difference may not be serious in filters operated at low rates, but when the high rates of filtration contemplated for this plant are used, unequal rates may affect the quality of the water.

Washwater troughs probably will be of reinforced concrete. The design now favored departs from customary practice in that the outside of the bottom of each trough is flat and level. If this design is selected, the trough will be set so that its bottom is about 6 in. above the sand.

Each of the troughs will be 2 ft. 2 in. wide and 2 ft. 8 in. wide outside. The depth of the trough will be 17 in. at the back end and 18 in. at the gutter end, giving a slope of 1 in. in a length of about 26 ft. This slope is less than that generally used. One reason for the greater depth at the back end is to provide strength for spanning the distance across the filter.

Thickness of the gravel bed in the filter will depend upon the type of bottom used. With the Wheeler-type, the depth of gravel above the top of the concrete slab will be about 13 in. A perforated pipe bottom, however, will require a gravel thickness of about 20 in. Material over 2 mm. dia. will be classified as gravel, and will be placed in layers. The probable thickness of gravel layers is given in in the accompanying tabulation:

GRAVEL SIZE AND THICKNESS

Size of gravel	Thickness of layer Perforated pipe	Thickness of layer Wheeler bottom
1/12 to ⅛ in.	2½ in.	2½ in.
⅛ to ½ in.	3½ in.	3½ in.
¼ to ½ in.	3½ in.	3½ in.
½ to 1 in.	4 in.	4 in.
1 to 2½ in.	6½ in.	0
	20 in.	13½ in.

It is contemplated that a bed of about 24 in. of sand having an effective size of about 0.65 mm. dia. will be placed on top of the gravel. It is to be noted that this size sand is coarser than that generally used in rapid sand filters.

As pointed out in the article preceding this, silicate treatment will be used to strengthen the coagulation, thus permitting the employment of coarser sand and faster rates of filtration without lessening the quality of the filtered water. Coarse material will lessen the friction head through the sand bed, and will permit faster rates of filtration to be used without a high initial loss-of-head and also without producing filter runs too short for practical operation.

Exact depth of sand will be determined after the sand has been added to a few filters and backwashing experiments conducted. It is planned to have the sand at rest as near the bottom of the washwater troughs as is possible wtihout causing sand to be lost in backwashing. Experiments on a small scale indicated that troughs with flat or nearly flat bottoms are less likely to cause loss of sand than troughs with round bottoms. The studies indicated that the sand at rest may be as close as 2 in. from the bottom of flat troughs, and that in backwashing it may expand upward considerably along the side of the trough without causing loss of sand.

Backwashing procedure

A 300,000-gal. tank, the bottom of which is 55 ft. above the troughs, will provide washwater storage. Washwater pumps will discharge into a 42.-in.-header pipe that runs along the west side of the filters and connects with the tank. In the filter pipe galleries there will be 30-in. pipes connected to this header and cross-connected at the east end of the filter building. The 30-in. line will be provided with a backwash rate-of-flow controller at its west end, near the point where it connects with the washwater header.

A backwashing rate is contemplated that will be sufficient to expand the sand bed 10 to 15 percent during the first part of the wash, and about 30 to 35 percent during the latter part of the wash. With the size of sand proposed, this backwashing rate will be about 9 and 16 gal. per sq.ft. per minute, respectively.

Surface wash will be used while the bed is expanded 10 to 15 percent. The period of backwash will vary, depending upon conditions, with a probable minimum of 2 min. and a maximum of 4 min.

An electrical connection from each operating table to the backwash controller will be so arranged that by pressing a button the controller can be set first to the low rate and then to the maximum rate. If this procedure works as well as expected, the backwash valve at the filter will be opened wide before the backwash is turned on. Should there be difficulty in operating in this manner, the backwash controller will be set to control at the maximum rate, and the lower rate of backwash will be controlled by the filter backwash valve.

Surface wash details

Although the type of surface wash to be used has not been decided definitely, it probably will be a system of piping with fixed jets. Bids may be received on two or three designs and the one considered best —on the basis of price and performance—will be selected. It is probable that the water for the surface wash system will be obtained from the washwater tank. It will have a connection separate from the backwash piping, however, to avoid a possible cross-connection between the settled water and the filtered water storage.

Installed along one side wall of each filter is the surface wash pipe of 12 in. dia. The surface wash laterals will connect to this header. One plan is to have 3-in. lateral pipe extend across the filter along each side of each washwater trough, making a total of 18 laterals. These pipes are to be supported with brackets fastened to the trough. One-inch pipe spaced about 3.2 ft. apart will extend downward to about 4 in. of the sand surface, and will end in a perforated cap. Holes in the caps will be of the desired size and located to direct the jets of water downward, probably at an angle of between 20 and 30 deg. to the horizontal. The exact angle to be used will be determined on the basis of trial runs.

The contemplated procedure for using the surface wash system in connection with backwashing is to open the valve on the surface washing system just in advance of opening the backwash valve. Most effective breaking up of mud balls appears to take place when the expansion of the sand bed is not greater than 10 to 15 percent. This is the reason for using an initial low rate of backwash. After the filter has been backwashed in conjunction with the surface washing system for a period necessary to break up the mud balls, the surface wash valve will be closed and the backwash valve opened wider to produce the maximum set rate of wash.

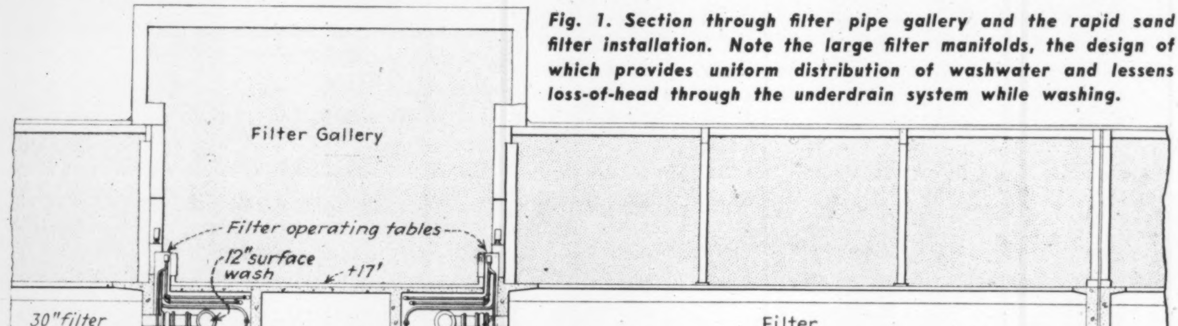


Fig. 1. Section through filter pipe gallery and the rapid sand filter installation. Note the large filter manifolds, the design of which provides uniform distribution of washwater and lessens loss-of-head through the underdrain system while washing.

Some consideration has been given to pumping the water through the surface washing system under higher pressure than that available from the washwater tank. This would require small openings in the caps, probably $\frac{3}{16}$ in. Present indications are that the cheapest procedure is to use water from the washwater tank. The size of the holes for this head of water (about 55 ft.) should be $\frac{1}{4}$ in.

The amount of water required through the surface washing system to produce rapid breaking up of the mud balls probably should be not less than 2 gal. per sq.ft. of filter surface per minute. The piping system will be constructed large enough to provide 3 gal., but the jets probably will be designed to give a lesser flow. The design will be such that the expense of changing the jet size or number of jets will be small. Operating experience will decide the final size of hole.

Although the filter units have a rated capacity of 4 mgd. each, they are designed for a maximum rate of 8 mgd. Filter rate controllers, therefore, will have to be capable of accurate control at least up to this maximum rate. The usual range of capacity for filter controllers is at least one-fourth the maximum rate; therefore, the rate controller should perform accurately at any rate between 2 and 8 mgd.

The rate controllers are to be of the 20-in. size and will be set about 25 ft. below average water level on the filters. To avoid excessive surging of the water in the filter effluent line at high rates of filtrations, the recovery section of the venturi tube will be limited to an angle of divergence of 5 deg. Most controllers now being manufactured have recovery section with greater angles of divergence.

Surging in effluent lines

In Fig. 3 is shown surge oscillations in three instances for a period of one minute in the head of water on a piezometer tube connected to the effluent lines of filters equipped with rate controllers of standard make. One piezometer was connected to a large filter with 24-in. rate controller, and another was connected to a small filter with a 6-in. rate controller. The third record on the chart is from a small filter with 2-in. venturi tube. The angle of divergence in the recovery section of this meter was about 5 deg., which is much less than the angles for the venturi sections of the larger rate controllers.

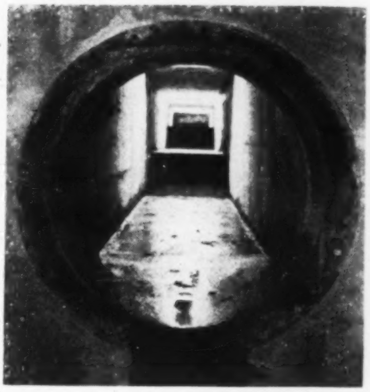


Fig. 2. Interior detail of the completed filter manifold.

The loss-of-head, filtration rate in gal. per sq.ft. per minute, and the throat velocity for each meter is shown in Fig. 3. The amplitude of the surge increases as the loss-of-head and as the velocity through the throat section of the meter increase. At a loss-of-head of 8 ft., the amplitude of the surge for the 2-in. meter would have been about twice that shown. The surges still would have been much smaller than the surges for the standard makes of rate controllers.

Velocities of the water through the throat sections of the meters were about 13 ft. per sec. for the larger filters. This is less than the velocity of most rate controllers at their maximum rated capacity. Surging tends to disturb the coagulated matter in the filter bed, and when the coagulation is weak and the loss-of-head is high the surge aids in causing some material to pass through the bed.

Reducing the angle of divergence should lessen the amplitude of the oscillation and permit fast rates of filtration to be used without danger of causing coagulated matter to pass through the filters.

Waste washwater drains of 42-in. pipe in each galley are connected to a reinforced-concrete waste washwater conduit running along the gallery east of the filters. The drain then is carried along the south side of the south settling and mixing basins to the waste washwater sumps, located south of the pumping station.

The raw water conduit is of sufficient size to permit four simultaneous filter washes, which might take place occasionally when the plant is enlarged and operating at its maximum capacity. Waste washwater will be pumped from the sumps into settling tanks, and from these tanks it will flow to the raw water intake. A large part of the sediment will deposit in the settling tanks. Should it prove undesirable to return sediment to the raw water there will be a bypass to permit the discharge of water into the lake a short distance from the intake. It is believed now that the sediment will be returned to the raw water nearly all of the time.

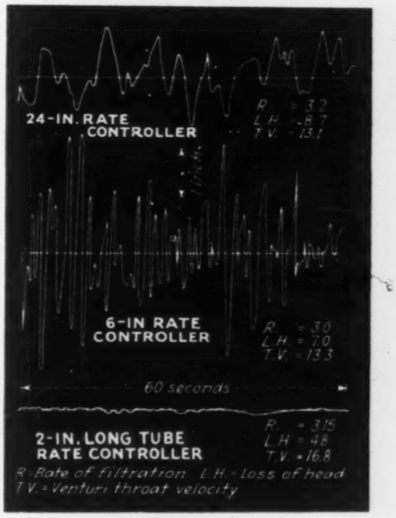
Filter operating tables, of which there are 80 in the four filter galleries, are to be constructed as integral parts of the retaining or parapet walls on each side of the galleries. The tables are to extend out into the galleries about 17 in. from the parapet walls. Six four-way valves for the six hydraulic valves in the pipe gallery will be connected to each table manifold, and will be connected to hand levers located on the table.

Gravel and sand handling

Consideration is being given to handling the sand and part of the gravel to and from the filters by hydraulic means. One plan is to pump the sand to storage bins. Then mixed sand and gravel will be pumped to a rotary screen, where gravel over $\frac{1}{4}$ in. dia. will be separated into sizes. Gravel less than $\frac{1}{4}$ in. in size and the sand mixed with it will be dried and sieved with dry screens.

The material will be returned to the filter by hydraulic means, handling each size of gravel separately. The gravel layers will have to be leveled after the return of each size.

Fig. 3. Surge oscillation tests on effluent lines equipped with standard rate controllers.



Chemical Handling Facilities

Facilities for the storage and distribution of chemicals constitute one of the most complex elements of water treatment plant design. At Chicago, for example, provision must be made for handling nine different kinds of chemicals, some of which are to be stored in volumes up to 500 tons. How these challenging problems were met, in addition to providing safeguards against such hazards as fire and dust, is told here.

ONE OF THE MAJOR OPERATIONS in processing water for treatment is the application of chemicals. The variety and volume of chemicals required at Chicago introduced numerous storage and distribution problems.

To accommodate the necessary facilities for chemical handling, a reinforced-concrete building 360 x 60 ft. will be provided. Located over the raw water conduits and mixing basins, it will extend to a height of about 83 ft. above average lake water level, or about 66 ft. above the water level in the mixing basins. A typical section through the building and the mixing basins is shown in Fig. 1.

Car Unloading—Most of the chemicals will be received in railroad cars brought in on a track located between the chemical building and the low-lift pumping station. At car unloading height there will be a platform along the entire length of the building. Dry chemicals suitable for handling with pneumatic conveyors will be unloaded in this manner. Chemicals shipped in bags, such as powdered activated carbon, will be transported by hand or power trucks. Liquid chemicals, such as sodium silicate and sulphuric acid, will be pumped or allowed to flow by gravity from the cars to the storage tanks. Chlorine will be received in one-ton steel containers.

Pneumatic Conveyors — Three pneumatic conveyor units are to be provided, each with a capacity of ten tons of alum or lime per hour. A 5-in. suction pipe will extend from points near the cars to the receivers, which will be located in the upper part of the chemical building. The receivers will discharge into screw conveyors that connect with storage bins.

A rotary bin gate is planned for the discharge of each bin, whether or not the chemical is to be discharged directly into a weigh hopper or into a spiral conveyor.

Storage facilities for the various chemicals include the following:

Alum or Iron—For alum storage there will be eight reinforced-concrete bins having a total capacity of about 400 tons. If iron compounds are used they will be stored in the alum bins. In addition to the bins provided exclusively for alum or iron compounds there will be an additional nine bins with 475 tons capacity available for lime, alum or iron.

Lime—Eleven reinforced-concrete bins having a capacity of about 575 tons will be reserved for lime storage exclusively. Should there be considerable use of lime, some of the bins for joint use of lime or alum may be used for lime.

Ammonium Sulphate—Three reinforced-concrete bins holding about 100 tons will be provided; when the bins are overloaded this chemical may be stored in bags.

Activated Carbon—Bags of activated carbon will be stacked on platforms at the railroad car and moved to floors above with hand or power trucks. Several rooms will provide storage for over 500 tons of carbon without crowding when the bags are stacked to a height of 4 to 5 ft. upon the platforms; storage may be increased to over 700 tons by using space not now intended for this purpose. Each carbon room will be provided with fireproof doors and facilities for fighting fire.

Bags of carbon will be dumped as needed into the weigh hoppers, using special rooms provided with bag-dumping hoppers. The latter are designed to reduce the escape of dust to a minimum, but the dump rooms will be provided also with exhaust ducts for dust removal.

Sodium Silicate—This chemical will be received in liquid form in tank cars and pumped directly to storage tanks. The plan is to fill a storage tank about one-half full of the concentrated sodium silicate and then dilute with an equal amount of water.

Sulphuric Acid—This acid will be purchased in carload lots and it will be discharged by gravity flow into tanks located below the level of the railroad track. As needed, small amounts of acid will be pumped to tanks in the top of the building.

Sodium Hexametaphosphate — If this material is used, provisions have been made to receive it in bags. These would be stored at convenient places on platforms similar to those to be provided for carbon.

Chemical feeding equipment

Chemicals distributed by means of dry-feeding machines first will pass through weigh-hoppers resting upon scales; the hoppers will be located above the dry-feed machines. Some of the hoppers will be placed directly beneath storage bins, permitting direct discharge from bin to hopper. Bins without underneath hoppers will discharge into spiral conveyors connected to weigh-hoppers located under other bins.

Lime and alum hoppers will hold about 2.5 tons each, and the activated carbon hoppers about 0.8 tons each; ammonium sulphate hoppers will hold about 0.5 tons each. A rotary bin gage will be provided for each weigh-hopper. For chemicals likely to flow in the dry state, such as powdered activated carbon, there will be an automatic closing device on the discharge of each hopper, or on each dry-feed machine.

Ammonium sulphate will be handled through weigh-hoppers, the same as the other dry chemicals. When stored in bags, it probably will be dumped first into the bins.

Dry-Feed Machines—The number of dry-feeding machines that will be provided for each chemical, and the maximum and minimum capacities of the machines, is given in the accompanying table. It is proposed to use the gravimetric belt-type of machine.

NUMBER AND CAPACITIES OF DRY-FEED MACHINES

Chemical	Number of Machines	Capacity in lb. per. hr. Min.	Max.
Alum	6	50	700
Lime	6	150	1,800
Ammonium sulphate	6	5	75
Activated carbon	9	20	600

Each machine will be equipped with an integrating or totalizing device to show total quantity of material passing through the feeder.

Lime Slakers—Each of the six dry-feed machines for lime will discharge into a slaker. The latter will be of the continuous type and of sufficient size to provide a slaking period of not less than 30 min. at maximum capacity of the machine. Warm water will be used to aid slaking. As the flow of water into the slaker will control the slaking period, a rotameter or similar flow-measuring device will be used.

Solution Boxes—Chemicals from each dry-feed machine will discharge into a solution box. Alum and ammonium sulphate will be dissolved completely before passing from the box. Insoluble chemicals, such as activated carbon, will be discharged from the dry-feed machine into a dissolving box similar to those used for soluble chemicals. Carbon will be wet thoroughly in the box and then be carried to the point of application as a suspension. Since lime is only slightly soluble it, too, will be handled largely as a suspension.

Chlorination equipment

Chlorination equipment is located on the lower floor of the chemical building; the general layout is shown in Fig. 2. The equipment will include 14 chlorinating machines of the capacity shown in the accompanying tabulation:

CAPACITY OF CHLORINATORS

Number of Machines	Capacity in lb. per 24 hr. Min.	Max.
4	500	2,500
7	150	750
3	60	300

Each chlorinator is to be of the manual control, solution feed, visible vacuum type. Some of the machines will be used for pre-chlorination and others for post-chlorination.

Scales—Two chlorine container rooms with eight chlorine scales will be provided. On each scale platform there will be a tank in which one or two one-ton containers of chlorine

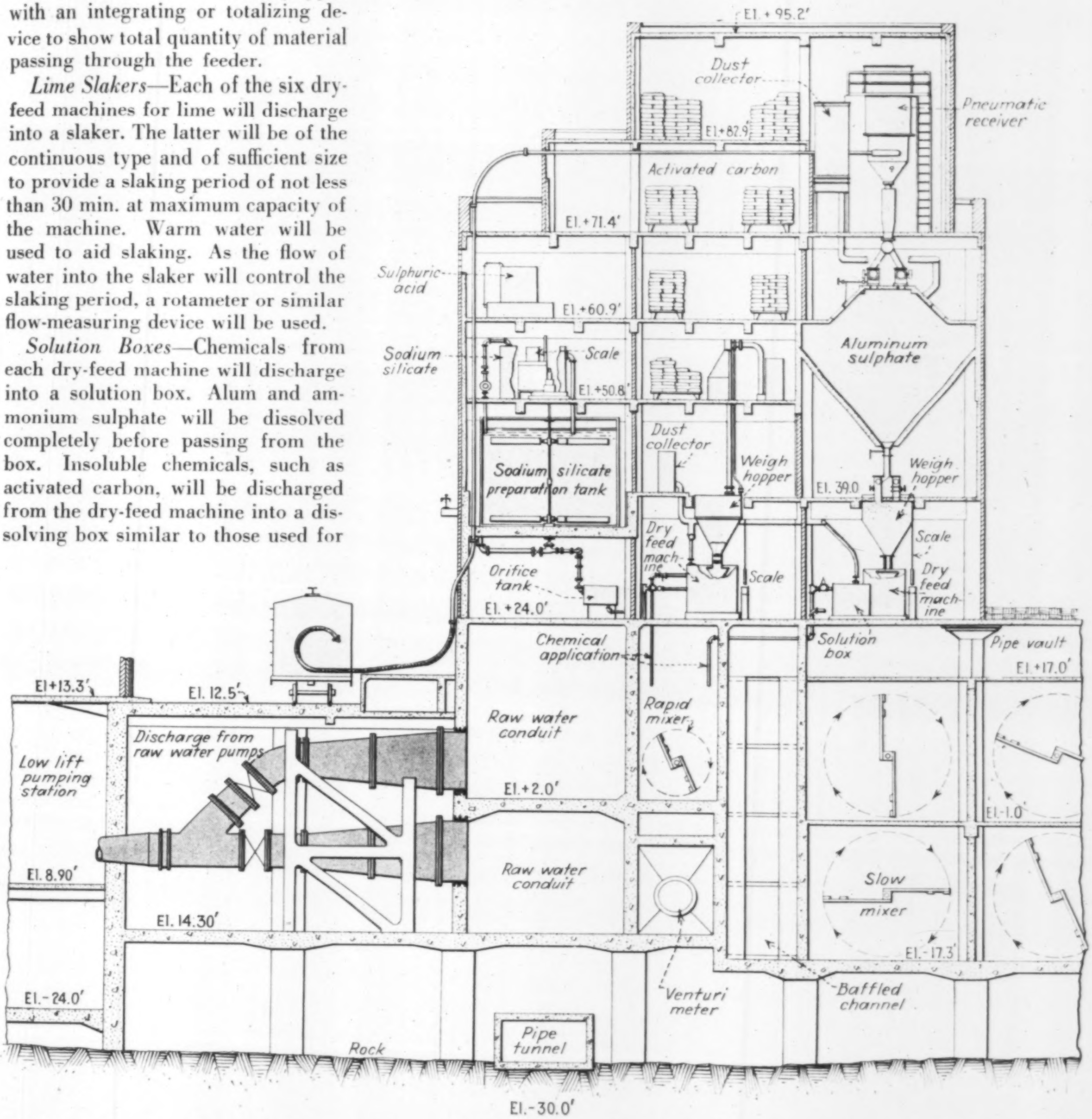

El. + 95.2'
Dust collector
El.+82.9'
Pneumatic receiver
Activated carbon
El.+71.4'
Sulphuric acid
El.+60.9'
Sodium silicate
Scale
El.+50.8'
Aluminum sulphate
Dust collector
Weigh hopper
Weigh hopper
Sodium silicate preparation tank
El. 39.0
Scale
Dry feed machine
Scale
Dry feed machine
Orifice tank
El. +24.0'
Chemical application
Solution box
Pipe vault
El. +17.0'
El+13.3'
El. 12.5'
Discharge from raw water pumps
Low lift pumping station
Raw water conduit
Rapid mixer
El. +2.0'
El. -1.0'
El. 8.90'
Raw water conduit
Slow mixer
El. 14.30'
El. -17.3'
El. -24.0'
Venturi meter
Baffled channel
Pipe tunnel
Rock
El. -30.0'

Fig. 1. Located over the raw water conduits and mixing basins, the chemical building provides for storage and distribution of nine different chemicals. This typical section illustrates the methods for handling, feeding and mixing.

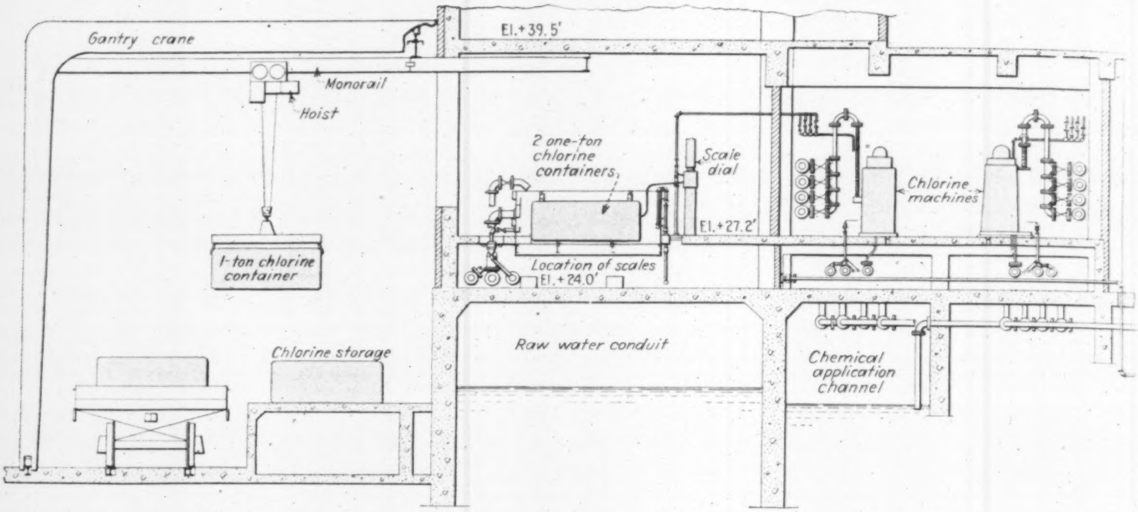


Fig. 2. General layout of the chlorine handling and distribution facilities. Fourteen solution-feed chlorinating machines will be used (of varying capacities from 60 to 2,500 lb. per 24 hr.); chlorine will be stored in one-ton containers.

will be set. The tank may be flooded with caustic soda in case of a leak from a chlorine container.

Application Points—Chlorine machines wil be connected by rubber or glass-lined piping to several application points within the plant. Main points of application will be in advance of the venturi meters. Prechlorination facilities are provided in the chemical application channels, and at points about one-half through the mixing basins.

Chlorine solution lines will run from the machines in the chemical building in the east end of the plant to the filtered water reservoirs in the west end, and also to the raw water bypass shaft. Ordinarily, the chlorine for post-chlorination will be added in the filtered water header connecting the small clear well reservoirs with the main filtered water reservoirs, but it may be added in the outlet shaft from the filtered water reservoirs.

During emergency periods when it might be necessary to bypass the filtration plant, chlorine will be added to the raw water in the bypass shaft before flowing into the filtered water reservoirs. Under such circumstances every effort will be made to apply all of the necessary chlorine to the raw water in the bypass shaft, but should it not be adequately chlorinated at this point, additional chlorine can then be added at the outlet shaft.

Preparation of silicate

Sodium silicate has to be partly neutralized with acid before it is applied to the water. To avoid the formation of a jelly, the concentration of silicate in the solution to which the acid is added cannot be great.

Equipment for preparation of the silicate solution will consist of six main solution tanks, three sodium silicate charging tanks, three acid weighing tanks, and three acid dilution tanks. In addition, there will be three concentrated acid storage tanks.

Charging tanks will be located above the main silicate solution tanks. Sodium silicate will be pumped from the storage tanks to the charging tanks, and definite volumes of the solution will be added to the main silicate tanks. The silicate then will be diluted with water until the concentration of silica is about 1.5 percent. To permit further dilution with water after addition of the acid the tanks will be filled to less than one-half their capacity.

Sulphuric acid will be pumped from storage to tanks in the chemical building. After weighing the concentrated acid, it will be added to about three times its volume of water in dilution tanks. The acid solution then will be added to the silicate solution in the main preparation tanks. In order to provide for rapid mixing of the acid with the silicate solution before the addition of the acid, the agitators in the main silicate tanks will be started.

After a period of aging, which will vary from 30 min. to 2 hr., the acid-treated silicate solution will be diluted to prevent it from forming a jelly on standing. A solution containing 0.6 percent silica will not jell.

Orifice boxes will be used for controlling the flow of the silicate solution to the points of application. Main points of addition to the water will be in the chemical application channels prior to the alum application.

Dust and fire control

Provisions will be made within the building to collect dust resulting from the handling of chemicals. Particular attention will be given to activated carbon, dust from which will be passed through collector bags.

There will be nine dust collector units. Three of the units will be for use in connection with the pneumatic unloading equipment, removing the dust from the lime and alum storage bin and weigh-hoppers. Three other units will be used to remove dust from the dry-feeding machines. The remaining three units will be used for removing the dust from carbon weigh-hoppers and bag-dumping hoppers.

Each of the three units used with the unloading equipment will have a capacity of 1,500 cu.ft. of air per minute; each of the other six units will have a capacity of 300 cu.ft. of air per minute.

Activated carbon and the paper bags in which it is shipped are inflammable and constitute a fire hazard. Furthermore, water cannot be used to extinguish carbon fires. Therefore, provision will be made to store the carbon bags in rooms with fire doors so that the rooms can be isolated. Carbon-dioxide gas will be employed to smother the fire.

Instruments for Operating Control

Because of the size of the plant and the great distance between interrelated operating units, much thought was given to centralizing control at a single point. Using a wide variety of hydraulic and electrical measuring and transmitting devices it was possible to do this. As a result, all of the operations will be placed under the direction of a dispatcher who will guide, with finger-tip control, the workings of the world's largest water treatment plant.

VENTURI and propeller-type flow meters, water-level gauges, chlorine residual and pH indicators, temperature, wind, rainfall and pressure gauges are some of the instruments that will supply information required to control plant operations.

Most of the information supplied by this equipment will be transmitted to a central control room located in close proximity to the points of major chemical application. This room is the nerve center of the plant. Here a "load dispatcher" will control all plant operations, basing his decisions on the information taken from a gauge board occupying an entire wall of the room.

Communication by telephone will be provided between the dispatcher's office and the pumping station, the chlorine room, the operating aisle of the chemical building and the filter building.

Metering of water passing through the plant will start at the outlet of the low-lift pumps. A venturi meter is installed in the discharge of each of these units, and registers of the indicating, integrating, recording type will be located on the pumping station floor. These meters will be used to check the efficiency of the pumping equipment.

What might be termed the master meters of the plant are three venturi meters located just ahead of the rapid-mix basins. Each of these has a combined concrete and cast-iron body, and its capacity ranges from 25 to 250 mgd. Meter readings will be transmitted to large illuminated dials in the chlorine room, the operating aisle adjacent to the dry-feed machines and to the control room. The three meters also are connected to a "summator" that will transmit its readings to indicating dials located in the pump room and the filter room. Dial readings will serve as a check on orders received from the dispatcher.

The next general location at which water passing through the plant will be metered is at the four entrances to the filtered water header. This header, located between the four clear wells under each battery of 20 filters and the two filtered water reservoirs, conveys filtered water from the wells to reservoir storage. Post-chlorination and ammoniation take place in the header, and control of these applications is dependent on the meter readings. These meters will be either of the venturi or propeller-type.

Final metering of the water will take place as it leaves the plant through the outlet shaft. Here the meter will be of the propeller-type, and, only one unit is required. It will show the combined pumping load of the three stations served by the filtration plant, and serve also as a control for the application of chlorine and ammonia when these chemicals are applied in the outlet shaft to the supply tunnels.

The bypass shaft, which permits delivery of lake water directly to the filtered water reservoir during an emergency, will be provided with a propeller-type meter. Its function is to insure accurate chlorination of the incoming raw water.

Special metering devices

In the control room there will be gauges to indicate water levels throughout the plant, starting with the lake level, including the raw water and settling basin levels, and terminating with the levels in the filtered water reservoirs.

Hydrogen-ion concentration in the raw water basin and the settled water header will be revealed by pH gauges. Residual chlorine will be registered, too, from points in the filtered water reservoirs and in the outlet shaft.

One of the most interesting of the gauges will show the direction and velocity of flow of water in the Calumet River. These readings, coupled with the direction and velocity of the wind, are significant in indicating the quality of water that must be handled in the following 24 or 48-hr. period.

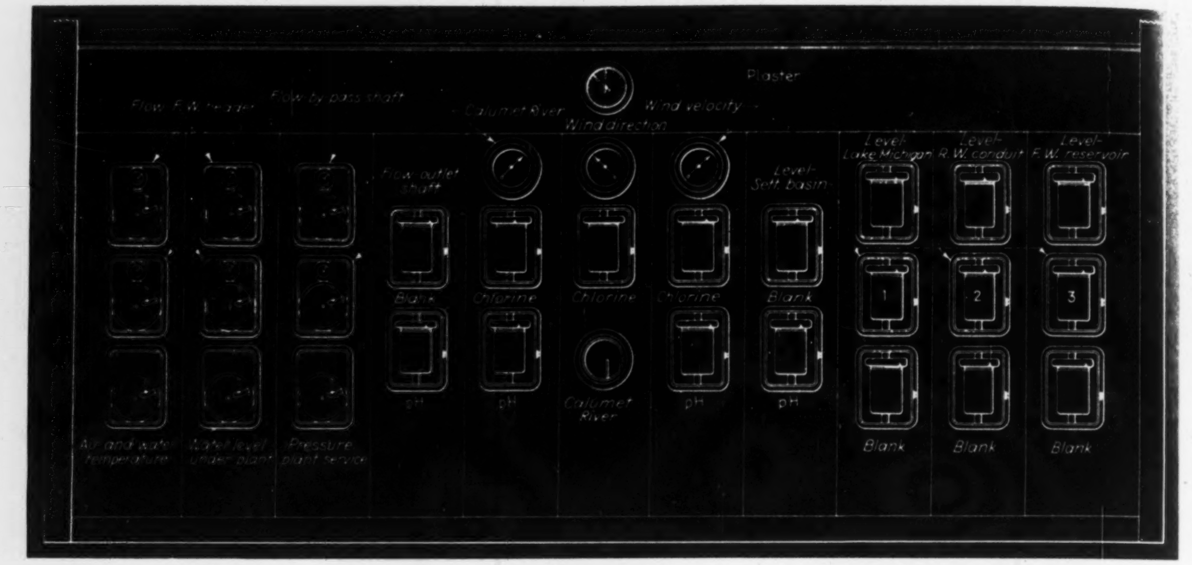
Pressure existing in the cold water service lines and the groundwater level under the plant also will be recorded.

Large indicating dials in the low-lift pumping statin will show the water level in the raw water conduit, each of the three settling basins and in the filtered water reservoirs.

In addition to the main gauge board in the control room, other gauge boards throughout the plant will supply information for the operation of auxiliary services.

In the sludge pump room, the continuous removal of sludge from each of the settling basins will be metered as it enters the receiving well. A portion of this sludge will be recirculated and the remainder will be discharged through two outfall lines to the floor of the lake at a point some 3,000 ft. south of the plant. Meters in the outfall lines to the lake and on the raw water makeup line to the receiving well will permit accurate control of the sludge returned to the mixing basins.

Another gauge board will be located in the room that houses the four washwater pumps. Here will be shown the elevation of the water in the filtered water reservoirs and in the washwater tank. Meters will indicate the amount of washwater pumped and the quantity of water used for house service.



"Nerve center" of the plant is gauge board occupying an entire wall of the control room. All plant operations will be controlled by a dispatcher whose decisions will be based on the information furnished by these gauges.

Many of the gauges and controls in the filter building will be of the conventional type. Recording and expansion gauges, push-button controlled. backwash rate-of-flow controllers and electrical valve position indicators are some of the newer developments that will be incorporated in the plant.

Filter gauges mounted at each control table will include combined loss-of-head and rate-of-flow indicating dials, recording gauges and recording sand expansion gauge.

The backwash rate-of-flow controller will be actuated by push buttons located at each control table. Depressing one of the push-buttons and holding it in this position will cause the controller to open to any desired rate-of-flow. When the button is released the controller automatically will maintain the flow passing through it at the time of release. A second push-button reverses the operation. An adjustable limit switch on the controller can be set for the maximum washwater rate desired.

Valve position indicators, of the electric spotter type, will be provided for each of the six valves on each filter control table. Each indicator will consist of ten lights mounted in a straight line under small diameter lenses. The closed position will be shown by a red light, the open position by a green light, and the intermediate positions by amber lights. Intermediate positions will be uniformly spaced between the closed position of the valve and the three-quarter open position.

Water used for backwashing filters will be metered by the four, backwash, rate-of-flow controllers. Water supplied for surface wash will be metered through venturi meters. Ceiling-hung dials actuated by these meters and showing the rate of flow will be located at center points in the filter aisles. Recorders and totalizers for the meters will be located at the west end of the aisles.

Large indicating dials at the west end of the filter building will show the total raw water pumpage and the total rate of filtration as indicated either by the meters at the entrances to the filtered water conduit or by the summation of the individual filter rate controllers.

Mounting of gauges

All gauge boards will be constructed of stretcher-leveled, cold rolled steel. The instruments will be of a type suitable for flush mounting; various sections of the boards will have deep U-shaped flanges on their sides which will serve as wiring raceways. In the control room, where the board occupies the entire south wall of the room, an area back of the board some 4 ft. wide will serve as a source of access to the wiring connections. This back space will be reached through a door opening into an adjacent corridor.

Registers for the venturi meters on the discharge outlets of the low-lift pumps will be mounted in pairs. The panel board, which incorporates two registers each, also will have mounted on it push-button controls for the motor-operated valves in the suction and discharge lines of the pumps. Each of the boards will be housed on the sides and back to form a cabinet and will incorporate the barometric-type manometers used in testing the venturi meters. Shelves will be provided for meter charts.

The propeller-type meter in each outlet and bypass shaft is suspended from a point above the center line of the shaft by a 6-in. pipe column. This in turn is braced against the walls of the shaft by two fixed and one movable leg, the latter hinged at the pipe column. Its length is such that when the outer end reaches a position slightly above the horizontal it wedges against the wall of the shaft. This arrangement provides a means of bracing the meter column and at the same time permits its ready removal. A similar design has been used by Chicago at one of the crib shafts.

Transmission of gauge and meter readings from the point of origin to the point or points at which they are indicated or recorded will be by air or by an electrical circuit. In general, long-distance transmission will be accomplished electrically.

Charts of recording meters will be circular or of the strip type depending on the use which will be made of the information and on the equipment which is available. For records infrequently referred to. seven-day charts may be used. In most cases, however, the chart will be the 24-hr. type.

Alarm clock for a sleeping giant!

HEAVY DUTY
Exide

RRRRRRRRRRRRRRING
12
1
2
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11

ALL over our country, from coast to coast, thousands of Diesels stand ready to heed Uncle Sam's call. Each is a powerful engine for Victory, but powerless until in motion. It takes a real battery to awaken the giant in a Diesel engine, a battery such as Exide.

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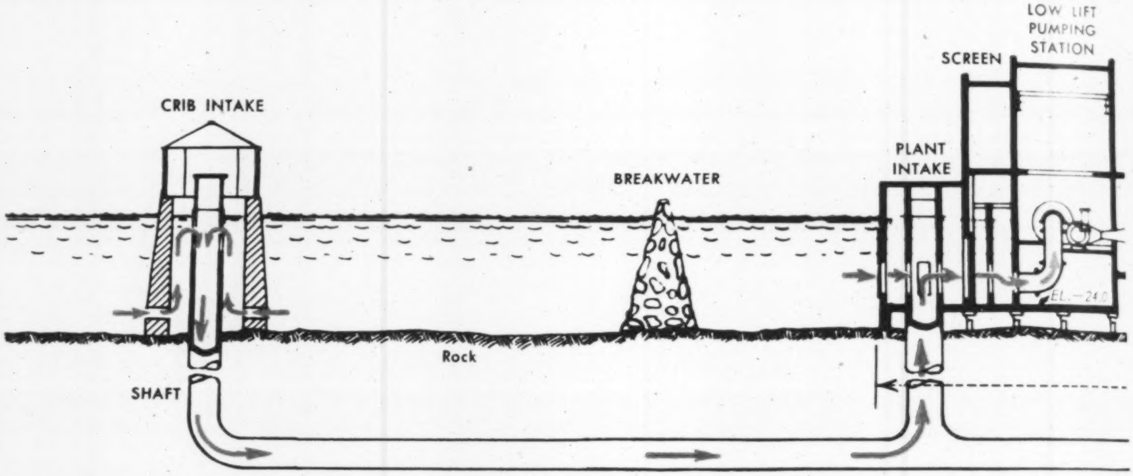
FOR CRANKING DIESEL ENGINES

Water Treatment at Chicago

Largest water-treatment plant in the world, the South District Filtration Project of Chicago is notable for more than its size. Its conception, design and construction synthesize contributions to knowledge made by scores of engineers. Here is an undertaking that typifies in function, structure and equipment the most advanced thinking in the field of water purification as it is practiced today.



Flow of water through the plant and the relationship of treatment processes are here indicated in diagrammatic form. And in the lower right hand corner is shown an architectural model from which it is possible to visualize the completed plant as seen from the air.

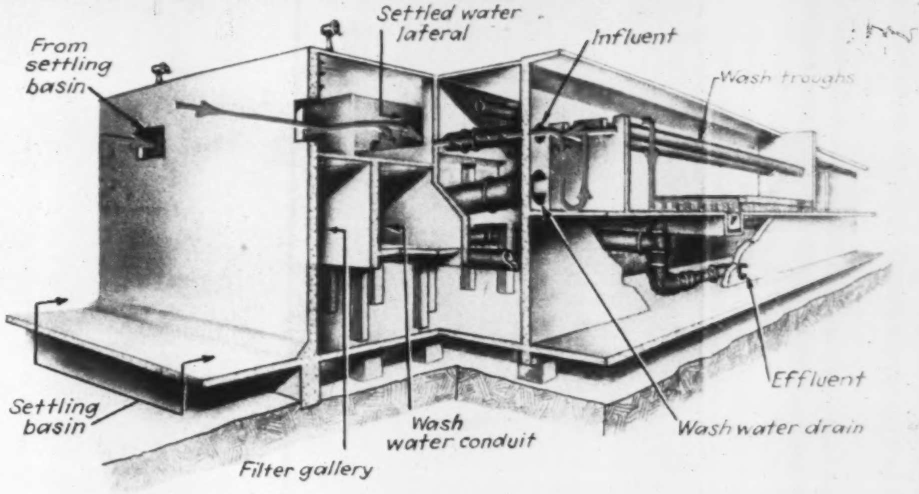
Raw water for this 320-mgd. treatment works will be taken from Lake Michigan, either through an offshore crib intake, an inshore intake, or from both points simultaneously. A tunnel connection with the intakes makes it possible to bypass the treatment facilities and dispatch raw water through the filtered water reservoirs to the city distribution system.

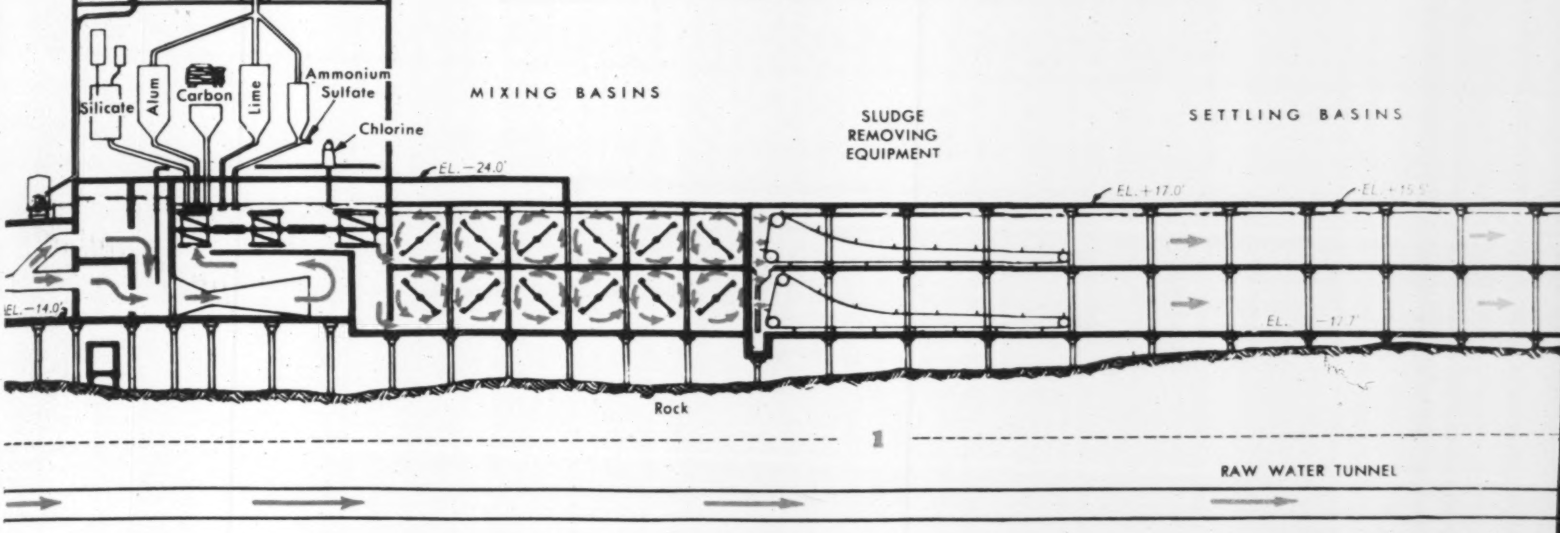
After passing through screens, the raw water is lifted by low-lift pumps to raw water conduits, from which it flows through venturi meters into rapid mixing chambers, where chemicals are introduced. The treated water then enters the two-story mixing and settling basins, in which the two levels operate in parallel. This sequence of operations is shown in sketch No. 1.

Leaving the settling basins the conditioned water is passed through a carbonation chamber after which it is applied to the rapid sand filters (sketch No. 2). There are four filter galleries, each of which contains 20 filter beds. It will be noted in sketch No. 3 that the latter are provided with both upward and surface wash facilities. Details of the pipe gallery arrangements between the filter beds are indicated in sketch No. 4.

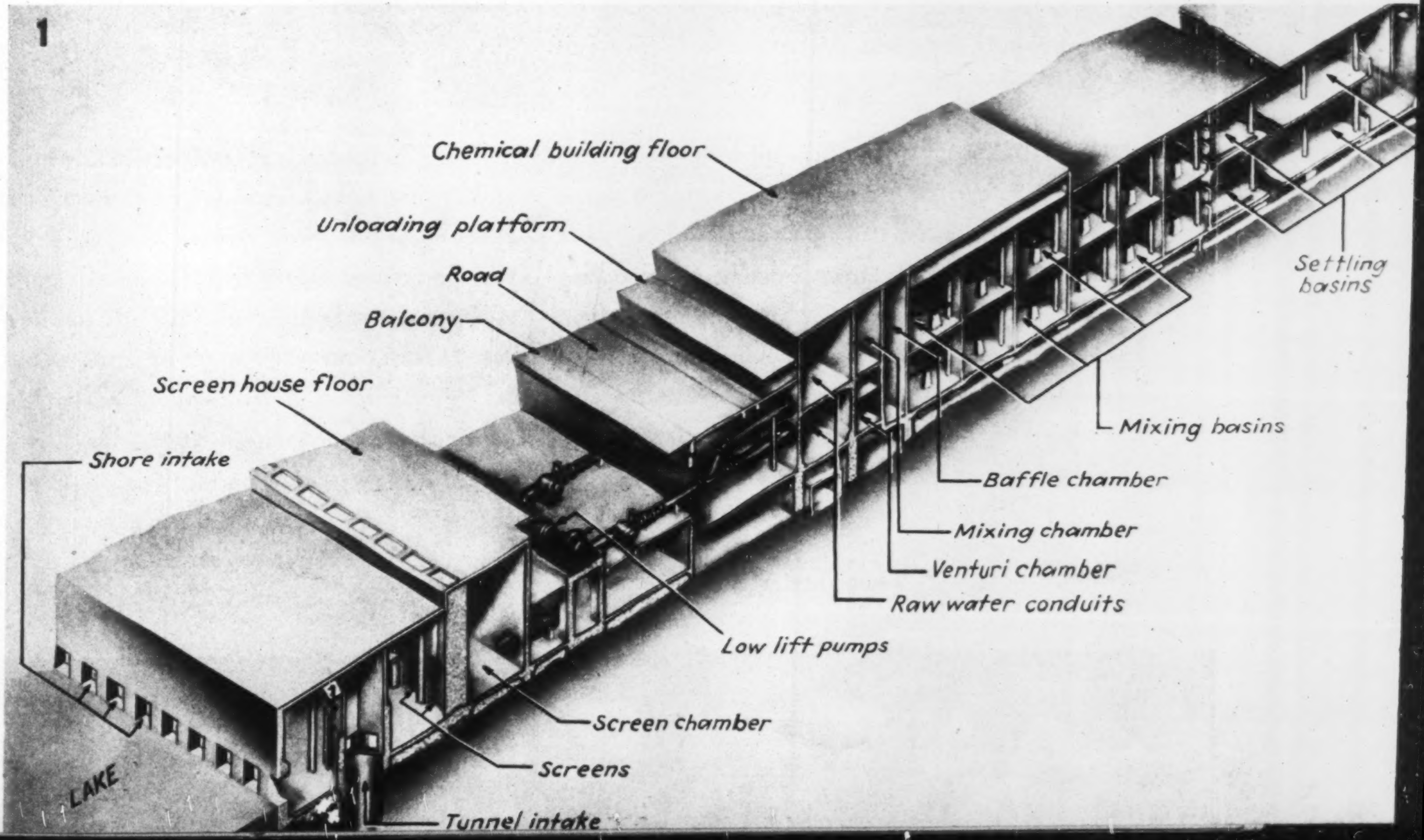
Filtered water is discharged into basins having a total capacity of 15 mg. and located underneath the filter beds. From these basins the water flows through a filtered water header to two storage reservoirs whose combined capacity is 36 mg. Provisions are made at this point for the application of chlorine and ammonium sulfate.

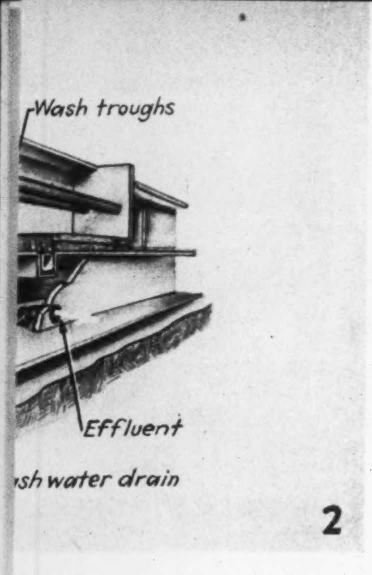
Also to be noted, as depicted in sketch No. 5, are the tunnel connections. One shaft is for the raw water bypass and the other connects to a tunnel leading to the pumping stations. Three existing pumping stations, now serving the South District, will be supplied with treated water from the new filtration plant.

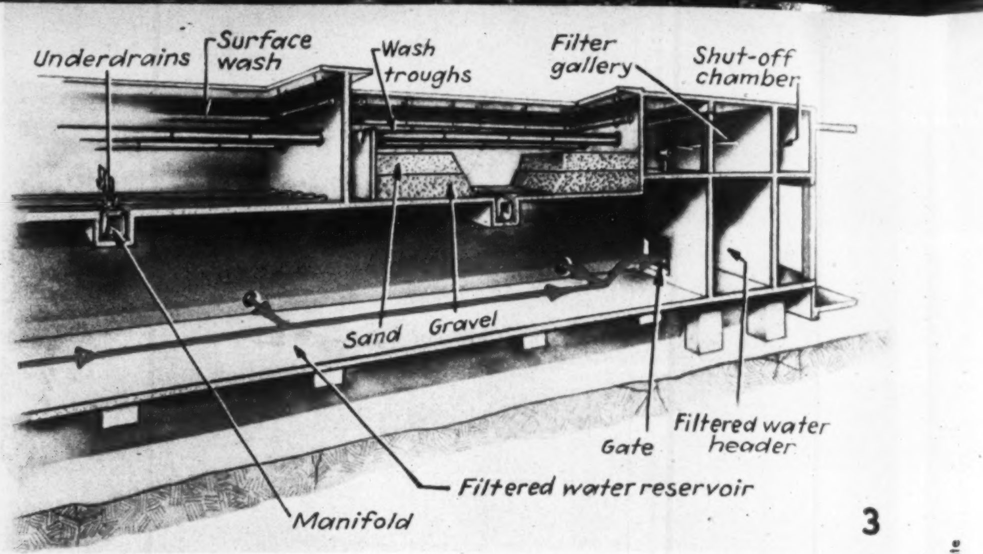

From settling basin
Settled water lateral
Influent
Wash troughs
Effluent
Settling basin
Wash water conduit
Wash water drain
Filter gallery

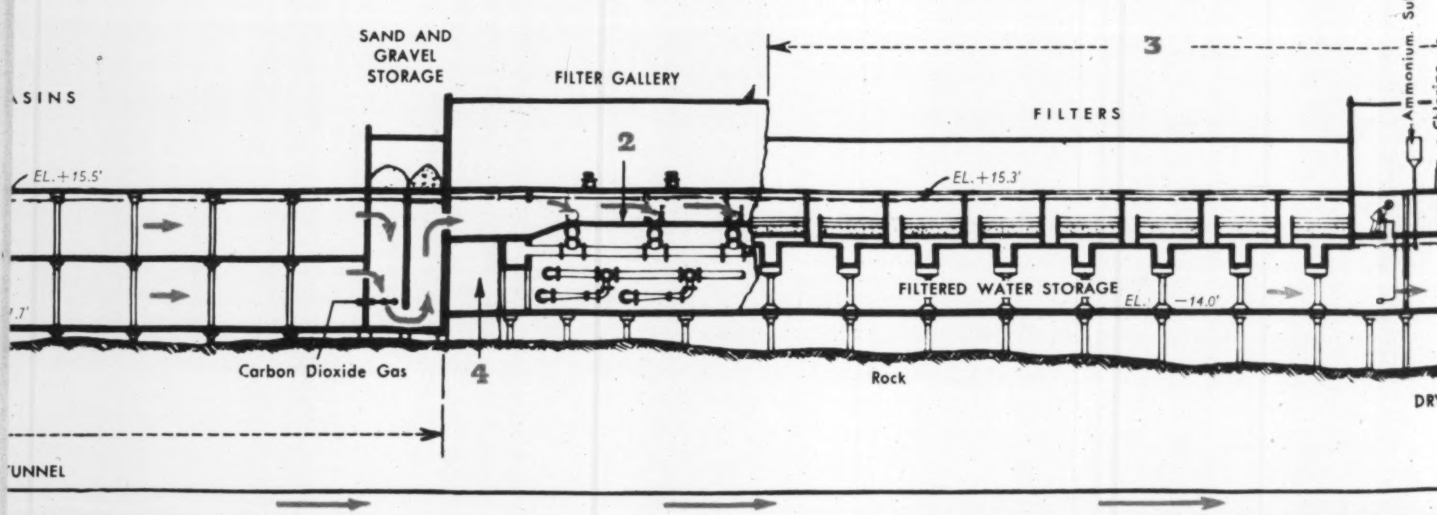

CHEMICAL BUILDING
PNEUMATIC CONVEYOR
Silicate
Alum
Carbon
Lime
Ammonium Sulfate
Chlorine
MIXING BASINS
SLUDGE REMOVING EQUIPMENT
SETTLING BASINS
EL. −24.0'
EL. +17.0'
EL. +15.5'
EL. −14.0'
EL. −17.7'
Rock
1
RAW WATER TUNNEL

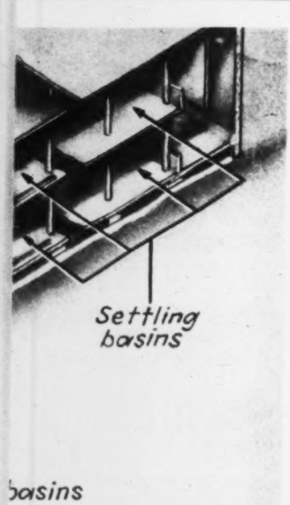
1

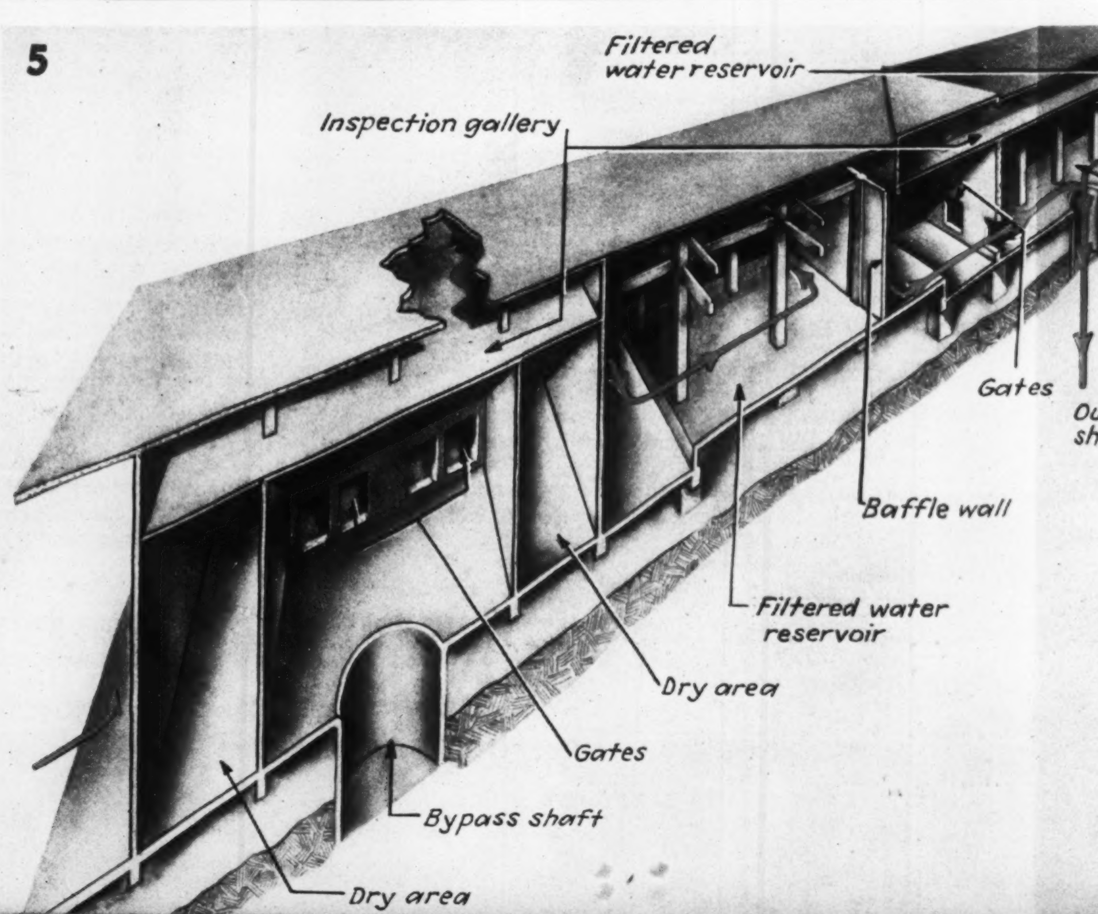

Chemical building floor
Unloading platform
Road
Balcony
Screen house floor
Shore intake
Settling basins
Mixing basins
Baffle chamber
Mixing chamber
Venturi chamber
Raw water conduits
Low lift pumps
Screen chamber
Screens
LAKE
Tunnel intake

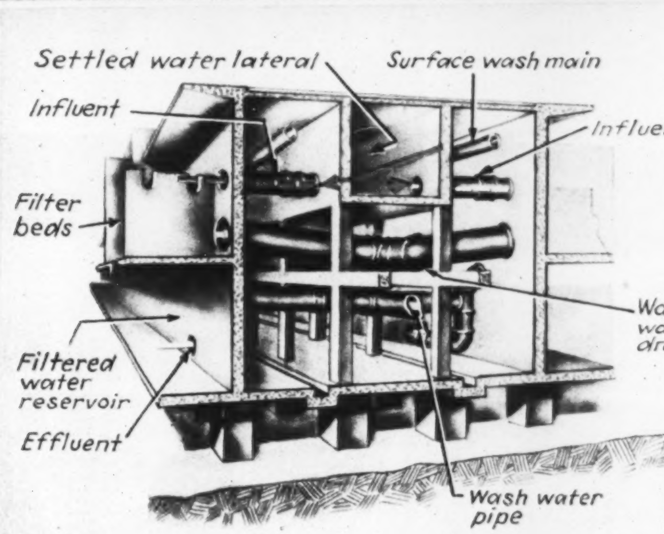

Wash troughs
Effluent
sh water drain
2


Underdrains
Surface wash
Wash troughs
Filter gallery
Shut-off chamber
Sand
Gravel
Filtered water header
Gate
Filtered water reservoir
Manifold
3

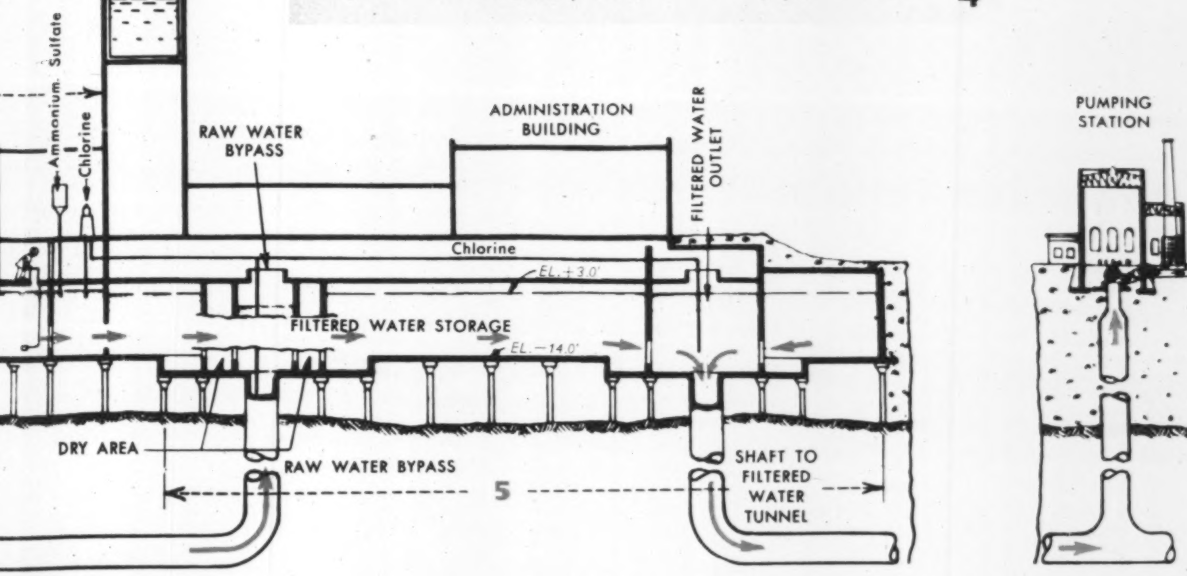

SAND AND GRAVEL STORAGE
FILTER GALLERY
3
SINS
FILTERS
2
EL. + 15.5'
EL. + 15.3'
.7'
FILTERED WATER STORAGE
EL. −14.0'
Carbon Dioxide Gas
4
Rock
DR
UNNEL
Ammonium Sulfate

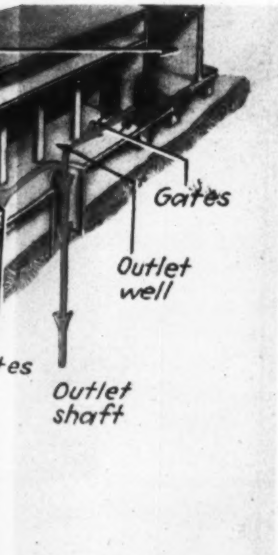

Settling basins
basins

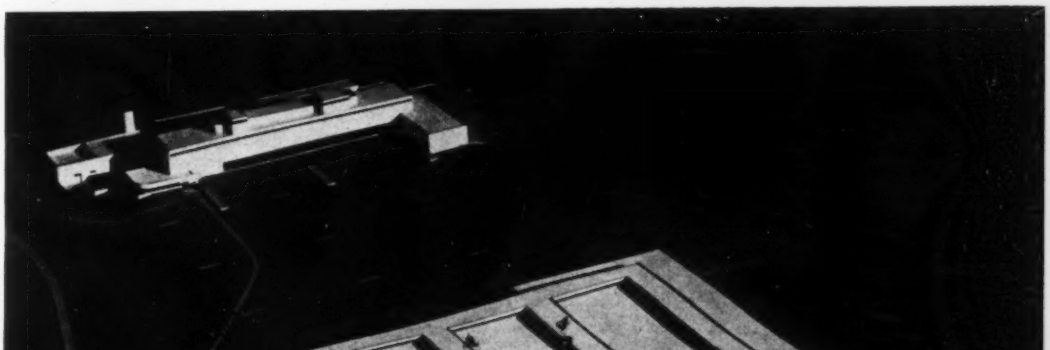

5
Filtered water reservoir
Inspection gallery
Gates
Ou sh
Baffle wall
Filtered water reservoir
Dry area
Gates
Bypass shaft
Dry area

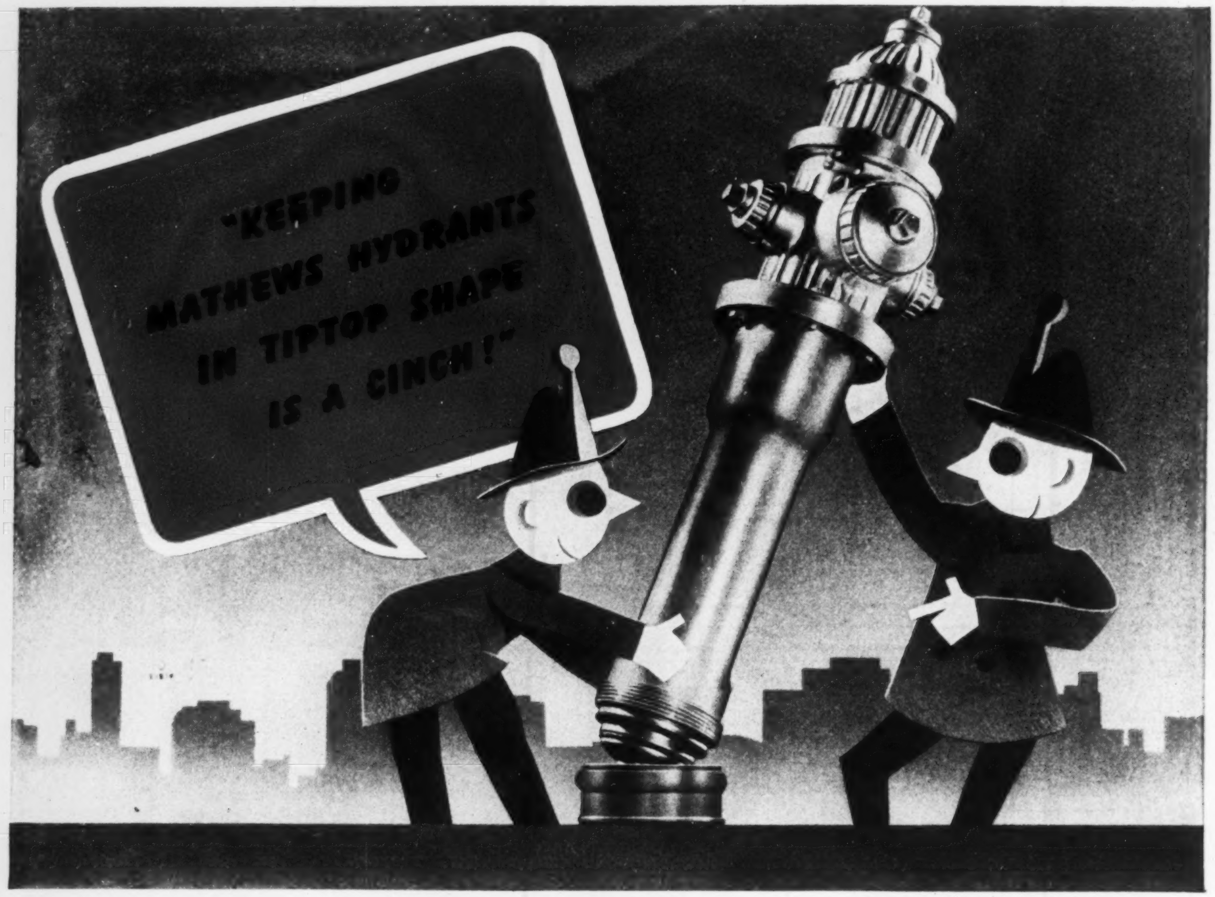

Settled water lateral
Surface wash main
Influent
Influent
Filter beds
Wash water drain
Filtered water reservoir
Effluent
Wash water pipe

4


WASH WATER TANK
Ammonium Sulfate
Chlorine
RAW WATER BYPASS
ADMINISTRATION BUILDING
FILTERED WATER OUTLET
Chlorine
EL. +3.0'
FILTERED WATER STORAGE
EL. −14.0'
DRY AREA
RAW WATER BYPASS
5
SHAFT TO FILTERED WATER TUNNEL
PUMPING STATION


Gates
Outlet well
tes
Outlet shaft




"KEEPING MATHEWS HYDRANTS IN TIPTOP SHAPE IS A CINCH!"

IN hundreds of communities where Mathews Hydrants are standard, a couple of extra Mathews Barrels take care of every emergency and all routine service. These barrels, or standpipes, contain all working parts including main-valve and drain-valve seats. They are inserted through an outer protection and screwed up tight. Why not repair *your* accidents this easy way? Why not do *your* overhauling in indoor comfort? This is a reminder to Mathews owners to make a war-time check of their spare barrels. To everybody else it's a big reason for specifying Mathews.

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★ ★ ★ *Attention — Builders of* ★ ★ ★

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WAR PLANTS
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HYDRO-TITE takes the place of lead for pipe jointing and does a better job—quicker and cheaper.

HYDRO-TITE is a self-caulking, sulphur base jointing compound used to joint bell and spigot cast iron water mains and soil pipe. It is made in powder form which insures uniformity and quick melting.

HYDRO-TITE has been used for more than 30 years by water companies and water departments everywhere. Hundreds of tons of Hydro-Tite are now being used on strictly War projects under War Department and Navy specifications.

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SALVAGED FOR RE-USE in new location after 50 years' service

CAST IRON MAINS, when abandoned or re-routed, can be salvaged and re-used, thus saving money for the taxpayer. For example, the 16-inch cast iron pipe shown above had served the City of Roanoke, Virginia, for 50 years in its original location. Last year it was removed to make way for a new armory and relaid in a new location to serve out its full life of more than a century.

We have on file many records of old cast iron mains which have been taken up and re-used, or sold to other cities for re-use, or sold as scrap. It is impossible to foretell future requirements or population shifts in metropolitan cities but any public official can be sure that, when water or sewer mains must be abandoned or re-routed, the pipe can be salvaged or re-used, if it is cast iron pipe.

Pipe bearing this mark Q is cast iron pipe

TRADE MARK REG.

Available in diameters from 1¼ to 84 inches.

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CAST IRON PIPE

CONTRACT UNIT PRICES

What contractors are bidding on different kinds of construction work

DAVIS DAM AND POWERHOUSE ARIZONA-NEVADA

OWNER: Bureau of Reclamation, Davis Dam Project, Arizona-Nevada, Kingman, Ariz. S. O. Harper, chief engineer.

PROJECT: Construction of Davis Dam, an earth- and rock-fill dam across Colorado River, approximately 30 miles west of Kingman, Ariz.; and diversion channel through left abutment which forms forebay with concrete penstock, outlet and spillway structures across downstream end of forebay channel. Crest of dam to be 138-ft. above river bed, 1,600-ft. long, and 50-ft. wide. Impervious central portion of dam embankment to consist of moistened and rolled embankment of clay, sand and gravel with blanket of same material extending over entire upstream portion of dam foundation. Embankments immediately up- and downstream from impervious portion will be semi-pervious, consisting of moistened and rolled rock screenings, with blanket of same material on entire downstream portion of dam foundation. Up- and downstream portions of embankment to be rock filled. Contract also includes cut-off trench, concrete cut-off walls, concrete penstock structures enclosing welded plate steel penstocks, trashracks, fixed-wheel gates, gantry crane, elevator tower, outlet structure between penstock and spillway structures, and spillway structure at left side of downstream end of forebay. Powerhouse to be located on left bank of river at downstream toe of penstock structure. It is to be of reinforced concrete, 110 x 448-ft., and to house five main generating units, station-service equipment, offices and other facilities.

CONDITIONS: Contractor to furnish sand, rock or gravel for concrete; sand for mortar and grout; sawdust, screened gravel for embedding drain pipes, under fill back of gravity wall, and roof covering; aggregate for porous concrete, roads and parking areas; rock and rock spalls; lumber for temporary tunnel timbering; form materials; wire (except insulated wire); nails; temporary metal supports; curing compound; oakum; welding electrodes and brazing rods; and other materials not part of completed structure, but necessary for completion. Government to furnish all other materials. Completion time, 1,200 calendar days. Rail facilities available to Kingman, Ariz., and highway to vicinity of dam site. Wage rates are: skilled labor, \$1.12½ to \$1.65 per hr.; semi-skilled, 87½c. to \$1.12½; and common 82½c. to 90c. No adjustment for increased wage rates will be made during the first year of the contract, but beginning at the thirteenth month, the amounts due for labor rates will be adjusted by the amount of 60 percent of the difference between the wages actually paid, and the wages which would have been paid if present wages were in effect.

BIDS: Two bids were received May 15, 1942, the contract low of \$18,996,392 and \$19,313,434.

LIST OF BIDDERS:

1. Utah Construction Co., San Francisco, Calif. (contract)	\$18,996,392
2. Davis Dam Constructors, Los Angeles, Calif	19,313,434

Item	Quan.	Unit Prices	
		(1)	(2)
1. Diversion, care of river, and unwatering foundations	L. S.	\$800,000.00	\$198,928.00
2. Excav., stripping sand and coarse aggregate deposit	200,000 c. y.	.24	.50
3. Excavation, stripping borrow pits	40,000 c. y.	.24	.50
4. Common excav., for diversion and forebay channel, and for road betw. dam embank. and penstock struct	545,000 c. y.	.30	1.00
5. Common excav., for penstock, outlet, spillway struct. and powerhouse	425,000 c. y.	.50	1.00
6. Rock excav., for diversion and forebay channel, for road betw. dam embank. and penstock struct, and above El. 520 for powerhouse and penstock, outlet and spillway struct	2,100,000 c. y.	2.50	2.45
7. Rock excav. below El. 520 for powerhouse and penstock, outlet and spillway struct	230,000 c. y.	5.00	3.00
8. Drill line holes for rock excav	160,000 l. f.	.55	.75
9. Excav., all classes, in grouting and drainage tunnel and shaft	700 c. y.	24.00	50.00
10. Excav., common, dam embank. fndn., above El. 455	955,000 c. y.	.50	.75
11. As above, below El. 455	40,000 c. y.	1.00	6.00
12. Rock excav.: footings of conc. cut-off walls under dam embankmt	600 c. y.	31.50	35.00
13. Excav., rock: open cut-off trench under dam embank. on east abut	800 c. y.	11.00	35.00
14. Common excav.: embank. toe drains	60 c. y.	2.50	15.00
15. Rock excav.: embank. toe drains	40 c. y.	11.00	35.00
16. Common excav.: switchyard	20,000 c. y.	.85	1.00
17. Rock excavation: switchyard	40,000 c. y.	.85	1.50
18. Com. excav.: control-cable gallery, trench	700 c .y.	2.50	5.50
19. Rock excav.: control-cable gallery, trench	700 c. y.	11.00	20.00
20. Fills back of gravity walls, for switchyard, and betw. pow. house and outlet struct	130,000 c. y.	.55	.25
21. Rock fill on fill back of grav. walls and on fills for switchyard	50,000 c. y.	.45	.25
22. Sand and gravel filter blanket under riprap	18,000 c. y.	1.80	1.00
23. Riprap	87,000 c. y.	.85	2.00
24. Road and parking-area surfacing	4,300 c. y.	2.50	3.00
25. Com. excav., borrow pits and transport to dam embankment	1,530,000 c. y.	.45	.30
26. Loading and hauling stockpile mat'l	1,940,000 c. y.	.32	.25
27. Separate, load, haul stockpiled mat'l	1,200,000 c. y.	.55	.35
28. Earth fill in dam embankment	1,300,000 c. y.	.11	.15
29. Rock screenings in dam embankment	730,000 c. y.	.11	.15
30. Rock fill in dam embankment	2,200,000 c. y.	.075	.15
31. Rubble-masonry walls	800 c. y.	26.00	30.00
32. Rubble-concrete paving	500 c. y.	26.00	20.00
33. Drill holes for setting fndn. drain. pipes	150 ea.	8.50	50.00
34. Drill drainage holes, under 25 ft. in fndn.	6,000 l. f.	5.75	2.50
35. As above, 25 to 50 ft. deep	1,000 l. f.	5.75	3.00
36. 6-in. sew. pipe drain, uncemented joints, embedded in gravel	400 l. f.	.75	2.50
37. 8-in. as above	7,000 l. f.	1.00	2.50
38. 12-in. as above	200 l. f.	1.20	2.50
39. 4-in. as above, embedded in porous conc.	None	....	....
40. 6-in. as above, embedded in porous conc.	None	....	
41. 12-in. as above, embedded in porous conc.	2,400 l. f.	6.50	4.50
42. 6-in. sew. pipe with cemented joints	600 l. f.	1.10	3.00
43. 12-in. sew. pipe with cemented joints	600 l. f.	1.35	4.50
44. Lay 18-in. concrete pipe	400 l. f.	1.60	5.25
45. 5-in. porous concrete tile drains	7,000 l. f.	1.30	1.00
46. Single porous concrete half-tile drains	20,000 l. f.	1.30	1.00
47. Double porous concrete half-tile drains	6,000 l. f.	1.70	1.50
48. Porous conc. under spillway and outlet struct	None	....	....
49. Screened gravel under fill back of grav. wall	200 c. y.	3.75	5.00
50. Drilling weep holes	1,000 l. f.	1.10	5.00
51. Core drilling 5½-in. holes to 30-ft	1,600 l. f.	11.50	20.00
52. Drill 1⅜-in. grout holes to 30-ft	50,000 l. f.	2.25	2.75
53. As above, 30 to 50-ft	100,000 l. f.	2.65	2.75
54. As above, 50 to 100 ft	10,000 l. f.	2.65	2.75
55. As above, 100 to 150 ft	10,000 l. f.	2.65	4.00
56. As above, 150 to 200 ft	100,000 l. f.	2.65	4.50
57. As above, 200 to 250 ft	5,000 l. f.	3.30	7.50
58. Place pipe and fittings for fndn. grouting and drainage	100,000 lb.	.19	.15
59. Place metal tubing and fittings for grouting contraction joints	30,000 lb.	.27	.25
60. Pressure grouting foundations	300,000 c. f.	1.60	1.50
61. Pressure grouting with packers	50,000 c. f.	3.20	2.00
62. Pres. grouting contract. joints and cooling system	2,000 c. f.	3.00	2.50
63. Drill holes for anchor bars and grouting bars in place	115,000 l. f.	1.05	1.00
64. Conc. in floor of forebay chan. and of temp. diversion chan. through spillway	12,500 c. y.	13.00	15.00
65. Conc.: slope paving of forebay channel	23,000 c. y.	22.00	25.00
66. Conc. in penstock struct. below El. 647, except trashracks, elevator tower	150,000 c. y.	7.00	8.00
67. Conc. in penstock struct. above El. 647, except elevator tower	6,500 c. y.	12.50	15.00
68. Concrete in trashracks	6,000 c. y.	35.00	35.00
69. Conc. in elev. tower and gate-erection tower	600 c. y.	60.00	35.00
70. Conc.: grouting and drain. tunnel and shaft	300 c. y.	30.00	28.00
71. Conc.: piers, walls of outlet struct., and spillway struct	55,000 c. y.	12.00	8.00
72. Conc.: radial-gate sill, spillway crest	57,500 c. y.	7.50	15.00
73. Conc.: floor of outlet and spillway struct.	17,500 c. y.	8.00	15.00
74. Conc.: bridges and walks of spillway struct. and in operating floors of outlet struct	1,000 c. y.	40.00	35.00
75. Conc.: superstructure of spillway	2,000 c. y.	35.00	35.00
76. Concrete in blockouts	400 c. y.	25.00	10.00
77. Make and place conc. stop logs in spillway struct	600 c. y.	25.00	50.00
78. Conc. in bulkhead gates and supporting columns for radial-gate openings in outlet structure	200 c. y.	25.00	50.00
79. Concrete in gravity walls	15,000 c. y.	10.50	8.00
80. Conc.: substructure of powerhouse	35,000 c. y.	15.00	15.00

81. Conc.: intermediate struct. of powerhouse	19,800 c. y.	22.00	25.00
82. Conc.: superstructure of powerhouse	9,900 c. y.	35.00	43.00
83. Second-stage conc. in powerhouse	18,500 c. y.	17.00	10.00
84. Conc.: footings of embank. cut-off walls	500 c. y.	15.00	17.50
85. Conc. in embank. cut-off walls (exc. footings)	400 c. y.	30.00	17.50
86. Conc.: parapet and curb walls on dam embank	850 c. y.	55.00	17.50
87. Concrete in control-cable conduit	1,600 c. y.	40.00	17.50
88. Conc. in precast-conc. cable-tray supports in control-cable conduit	20 c. y.	100.00	30.00
89. Placing reinforcement bars	14,000,000 lb.	.026	.03
90. Place metal tubing and fittings for conc.-cooling system	250,000 lb.	.11	.15
91. Cooling concrete	180,000 c. y.	.45	.40
92. Chip and roughen concrete surfaces	2,000 s. y.	4.00	1.25
93. Finishing lighting recesses	165 ea.	5.00	5.00
94. Place metal sealing strips	25,000 l. f.	.50	.50
95. Place metal cover plates over vent grooves	2,500 l. f.	.60	.75
96. Place rubber water stops	500 l. f.	.90	.15
97. Placing joint filler	58,000 s. f.	.25	.25
98. Construct control joints	300 l. f.	1.00	2.00
99. Construct asphalt seals	2,100 l. f.	3.00	10.00
100. Insulate rein. bars and electr. metal conduit	20,000 sect.	.15	.25
101. Place roofing on main powerhouse roof	32,000 s. f.	.50	.15
102. Place insulation, low roof of powerhouse	16,000 s. f.	.40	.10
103. Place asph. saturated felt roofing, incl. flashing	20,000 s. f.	.25	.15
104. Place membrane waterproofing and rein. fabric and joint mat'l. in conc. cover slab over memb. waterpr'f'g	10,800 s. f.	.30	.20
105. Dampproofing outside powerhouse walls	1,800 s. y.	.60	.30
106. Inst. gate frames and guides for fixed-wheel and bulkhead gates	943,000 lb.	.06	.05
107. Inst. fixed-wheel gates and metalwork for gate counterweights and gate-erection tower	2,245,000 lb.	.035	.03
108. Install bulkhead gates	270,000 lb.	.035	.02
109. Inst. gate hoists, spillway fixed-wheel gates	555,000 lb.	.025	.03
110. Inst. gate hoists, penstock fixed-wheel gates	375,000 lb.	.035	.035
111. Inst. stop-log guides, slide plates, seal supports	390,000 lb.	.045	.025
112. Install trashracks	1,140,000 lb.	.035	.015
113. Install penstocks	1,625,000 lb.	.035	.03
114. Inst. draft-tube pier noses	155,000 lb.	.03	.025
115. Erect. str. steel roof framing and crane-runway beams for pow'hse	850,000 lb.	.03	.025
116. Install track rails	268,000 lb.	.03	.02
117. Install cranes	1,482,000 lb.	.02	.02
118. Inst. std. metal pipe, fittings and valves, under 6-in	135,000 lb.	.14	.10
119. As above, over 6-in. dia	250,000 lb.	.05	.08
120. Install metal stairways	30,000 lb.	.08	.05
121. Inst. metal frames for hatchways, manholes, floor plates and grating	31,200 lb.	.13	.05
122. Inst. metal gratings and covers for floor openings	43,200 lb.	.03	.02
123. Install metal inserts	12,500 lb.	.23	.04
124. Inst. oil-storage tanks and accessories	75,000 lb.	.02	.04
125. Install pumps	15,000 lb.	.07	.05
126. Install miscellaneous metalwork	96,600 lb.	.20	.12
127. Construct timber guard rails	26 M bm.	50.00	65.00
128. Inst. embedded elec. metal conduit, to 1¼-in. dia	40,000 l. f.	.50	.30
129. As above, 1¼ to 3-in	24,000 l. f.	.75	.40
130. As above, over 3-in. dia	900 l. f.	1.00	.50
131. Inst. elec. non-metallic conduit	6,000 l. f.	.80	.35
132. Inst. ground wires and ground rods	20,000 lb.	.10	.25
133. Inst. elec. cable for resistance thermometers, strain meters, and joint meters embedded in concrete	8,000 l. f.	.30	.25
134. Inst. copper tubing for hydraulic pressure piezometers	2,500 l. f.	.40	.50
135. Transport freight of all kinds for Govt. or agents, other than contractor, between railroad and dam site	13,300 ton	4.00	4.00
136. Constr. 24-in. sew. pipe drains, with uncemented joints, embedded in gravel	250 l. f.	2.50	3.00
137. Lay 24-in. sew. pipe with cemented joints	100 l. f.	2.50	3.00

SUBWAY, CHICAGO

OWNER: City of Chicago, Dept. of Subways and Superhighways.

PROJECT: Construction of concrete portal structure, remodeling of existing elevated structure, and appurtenant work at south end of State Street Subway (Contract S-1B) in connection with joining of subway and elevated structures. Junction of subway and elevated line of Chicago Rapid Transit Co. is near 13th St. in Chicago.

CONDITIONS: Contractor to furnish all materials except structural steel and complete work in 160 calendar days after start of construction. Partially financed by PWA funds. Highway and water transportation facilities available. Wage rates are: skilled labor, \$1.62½ to \$2.00 per hr.; semi-skilled, \$1.10 to \$1.70; and common, \$1.02½.

BIDS: Four bids were received April 23, 1942, ranging from the contract low of \$696,160 to \$749,598.

LIST OF BIDDERS:

Bidder	Amount
1. Kenny Constr. Co., Chicago, Ill. (contract)	\$696,160
2. Paschen Contractors, Inc., Chicago, Ill.	736,032
3. G. Kehl Sons, Chicago, Ill.	739,760
4. Michael J. McDermott & Co., Chicago, Ill.	749,598

		Unit Prices		
Item	Quan.	(1)	(2)	(3)
1. Earth excavation	15,000 c. y.	\$6.00	\$4.12	\$5.00
2. Remove exist. column footings	300 c. y.	15.00	12.88	17.00
3. Sand backfill	7,500 c. y.	1.75	2.12	1.90
4. Class A concrete	1,450 c. y.	17.00	15.46	15.00
5. Class B concrete	2,600 c. y.	22.00	20.62	20.00
6. Sub-piers	23,000 c. f.	2.00	1.83	2.50
7. Reinforcement steel	730,000 lb.	.06	.0515	.05
8. Shoring exist. elevated struct	L. S.	60,000.00	90,478.38	100,300.00
9. Raising exist. elevated struct	L. S.	11,980.00	17,395.00	20,000.00
10. Remove, relocate exist. track stringers and stringer bracing	60 tr. spans	600.00	837.50	550.00
11. Erect new struct. steel (furnished)	1,075 ton	77.00	103.00	80.00
12. Furn. and erect. misc. new struct. steel	5,000 lb.	.10	.19	.20
13. Steel plate seal	200 l. f.	1.25	1.60	1.50
14. Ornamental iron fence	30,000 lb.	.15	.1772	.15
15. Bitum. pavement with conc. base	200 s. y.	3.25	5.80	4.10
16. Bitum. pavement with macadam base	1,400 s. y.	2.40	4.51	2.75
17. Concrete pavement	6,000 s. y.	3.00	3.80	2.75
18. Sidewalks, curbs and gutters	3,800 c. f.	1.00	1.03	.85
19. Premolded joint filler	4,200 s. f.	.25	.19	.25
20. 10-in. vitr. tile drain	670 l. f.	1.70	1.93	2.50
21. Painting structural steel	L. S.	14,600.00	15,462.00	13,500.00
22. Fill concrete	50 c. y.	10.00	10.00	10.00
23. Rock excavation	50 c. y.	5.00	5.00	5.00
24. Grout for stopping leaks	50 bbl. cem.	10.00	10.00	10.00
25. Partial removal and support of remainder of bldg. 1	L. S.	1,400.00	257.00	450.00
26. As above, Building 2	L. S.	2,000.00	322.00	550.00
27. As above, Building 3	L. S.	700.00	129.00	300.00
28. Support and rehabilitation of Bldg. 4	L. S.	2,700.00	2,190.00	2,450.00
29. Emergency exit doors and misc. steel	3,200 lb.	.28	.31	.30
30. Misc. iron castings	15,000 lb.	.15	.22	.22
31. Bell and spigot cast iron pipe, over 12-ft. long	48,000 lb.	.09	.10	.095
32. B. & S. cast iron pipe, from 3 to 12-ft. long	14,500 lb.	.10	.115	.11
33. B. & S. c. i. pipe, under 3-ft., and fittings	7,500 lb.	.13	.154	.14
34. Electr. work for subway portal	L. S.	10,000.00	6,584.00	10,550.00
35. South portal interlocking tower (non-PWA)	L. S.	26,000.00	24,458.00	24,350.00
36. Sub-piers for interlock. tower (non-PWA)	3,700 c. f.	2.00	1.99	3.10
37. Wooden handrail (non-PWA)	1,200 l. f.	1.25	1.41	2.00
38. Remove, install track and spec. trackwork (non-PWA)	L. S.	64,000.00	64,015.00	70,000.00
39. Reconstruct power distrib. system	L. S.	33,000.00	32,933.00	36,000.00
40. Signal system	L. S.	11,100.00	11,101.00	12,500.00
41. Maintain exist. communication sys.	L. S.	4,540.00	4,565.00	5,000.00
42. Misc. electrical work	L. S.	2,800.00	2,805.00	3,200.00

HIGHWAY PAVING, IOWA

OWNER: Iowa State Highway Commission, Ames, Iowa.

PROJECT: Concrete paving 6.606 miles of access roadway from Des Moines, Polk County, Iowa, to west entrance of Des Moines Ordnance Plant. In addition to paving work, the project involves construction of driveways, sidewalks, curbing, paving intakes, slope drain, and incidental concrete masonry.

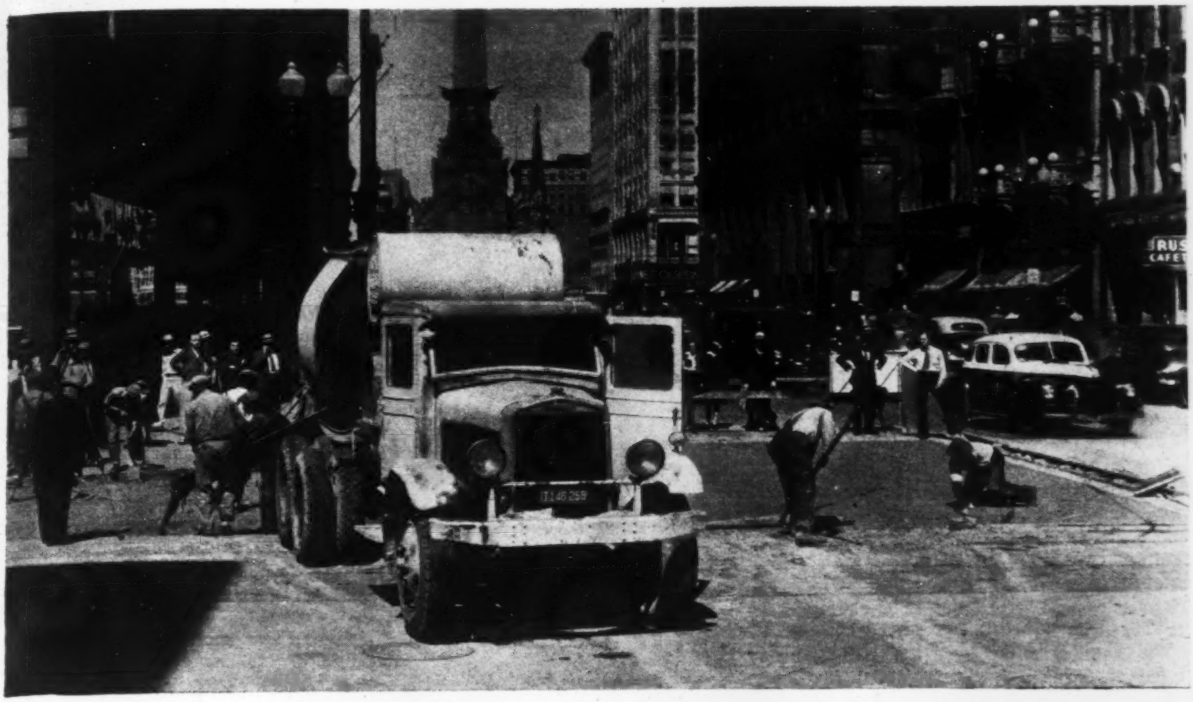
CONDITIONS: Rail and highway transportation facilities available. Contractor to furnish all materials and complete work in 50 working days. Minimum wage rates stipulated are: skilled labor, 75c. per hr.; semi-skilled, 60c.; and common, 50c.

BIDS: Four bids were opened April 21, 1942, ranging from the contract low of \$279,386 to \$365,390.

LIST OF BIDDERS:

Bidder	Amount
1. Fred Carlson Co., Decorah, Iowa (contract)	\$279,386
2. McLaughlin & Sons, Des Moines, Iowa	353,856
3. Booth & Olson, Sioux City, Iowa	362,346
4. Western Constr. Corp., Sioux City, Iowa	365,390

			Unit Prices		
Item	Quan.		(1)	(2)	(3
1. Std. conc. pavement, Class 2 or 3 coarse aggregate	100,958.6	s. y.	\$2.65	\$3.36	\$3.46
2. Concrete driveway	1,175	s. f.	.30	.45	.30
3. Concrete sidewalk	24,280	s. f.	.24	.32	.30
4. 3-in. curb	4,680	l. f.	.075	.12	.10
5. Type A flumes	7	ea.	90.00	90.00	85.00
6. Concrete slope drain	40	l. f.	1.50	3.00	2.00
7. Single type E paving intakes	3	ea.	125.00	150.00	150.00
8. Double type E paving intakes	17	ea.	200.00	225.00	175.00
9. Type E-M paving intake	1	ea.	250.00	300.00	225.00
10. Concrete masonry	15	c. y.	40.00	30.00	40.00



'INCOR' CHANGES "NEXT WEEK" INTO "Tomorrow"

AMERICA is fighting against time—every day saved brings victory nearer. Time-saving is 'Incor's contribution to the nation's all-out war effort. 'Incor' changes next-week into tomorrow . . . concrete placed today is in use tomorrow . . . roads, streets, airport runways, industrial floors, loading docks, machinery bases . . . in use days and weeks sooner.

Repaving four blocks of Maryland Street in traffic-congested downtown Indianapolis called for 5-inch concrete resurfacing on both sides of car tracks. R. M. Bowen and W. D. Vogel, Indianapolis contractors, used ready-mixed 'Incor' concrete exclusively. On intersection shown, excavation started morning of Sept. 10, pavement poured 2 p. m. same day, opened to traffic following morning—minimum interference to merchants and public. Use 'Incor'* 24-Hour Cement for top speed at lowest cost. Write nearest Lone Star office for service data.

*Reg. U. S. Pat. Off.

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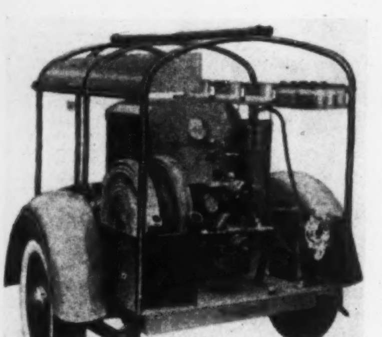
Equipment for Waterworks Service

The tremendous impact of wartime on American industry during the last year has been apparent in all manufacturing endeavor, but has been particularly noticeable in the waterworks field, since water supplies are vital to meet accelerated industrial demands as well as normal civilian requirements.

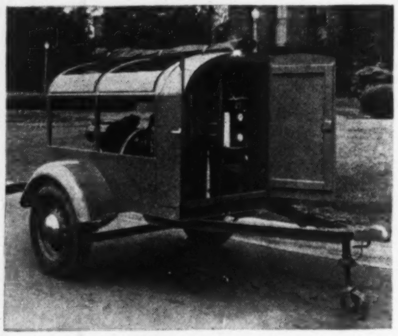
Principal developments in the waterworks field—in addition to many adjustments to meet individual needs—seem to have been in two classes. The first has been the evolution of a number of types of portable or mobile purifying devices that may be rushed to the scene of any emergency or may even supplement much of the normal water processing equipment of a community in case of need.

Proportioneers, Inc., of Providence, R. I., recently announced the development of a "Blitz-Buggy," a model of which is shown in the first column on this page. Built in two sizes, the units are available for field emergency use in disinfection, fire-fighting and decontamination or other chemical treatment in general.

The smaller of the two units (illustrated) is equipped with a V-8 85-hp. engine direct-connected to a centrifugal pump of 400 gpm delivery capacity against pressure of 120 lb. or 200 gpm. against 200 lb. pressure. The high capacity Chem-O-Feeder for hypochlorite solution (or other chemicals), has a chlorine delivery capacity up to 200 lb. per 24 hr. and downwards to a fraction of a pound per day. Storage racks provide for one case of nine 5-lb. cans of high-test hypochlorite and bottles of hypochlorite solution in addition. The larger "Blitz-Buggy" is equipped with additional feeders. The interesting feature of the development is that these additional units may be used in place, or may be removed readily for leaving at desirable points, while the "Buggy" goes on to serve at another point of need. The quickly demountable units are self-contained with both motor and gas-engine drive. One feeder is meter-operated to provide proportional feed where desired.



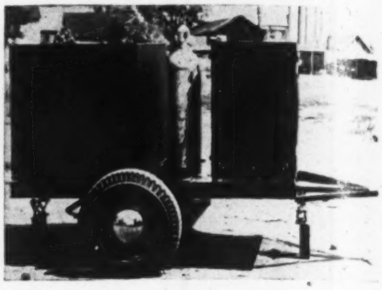
Wallace & Tiernan Co., Inc., of Newark, N. J., have contributed the two units shown in the center column. The first is a mobile chlorinator, a trailer type unit, designed to provide positive protection of water supplies under emergency conditions, or to meet temporary needs for chlorination.



The unit provides for closely controlled solution feed of chlorine over a wide range of application rates. It employs the *W&T* vacuum principle and is powered by a 5 hp. gasoline engine mounted on the trailer. The unit is equipped with all accessories for emergency use in connection with the main and has all needed tools, carrying two 150-lb. chlorine containers. Gross weight is 2150 lb.

The lower picture shows a portable chlorination unit designed for loading on a truck to meet emergency calls. It can be used for dead-end flushing, main sterilization and other chlorination needs away from the plant. Wherever a source of water at sufficient pressure to operate an injector is available, the unit provides for a well diffused solution feed.

At the top of the third column is a portable, trailer-type water sterilizer developed by the *Everson Mfg. Co.*, of 214 W. Huron St., Chicago, Ill. Of military type, this SterElator plant is mounted on a pneumatic-tired trailer and is complete with manually operated SterElator, self priming pump, intake and outlet hose, and racks for four standard high pressure drums of chlorine.

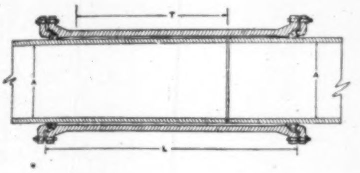


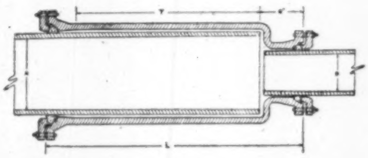
In the lower half of the third column is a portable ozone unit, developed by *Technicraft Engineering Co.*, of 5610 S. Soto St., Los Angeles, Cal., which is said to produce pure, clear, colorless, tasteless and odorless water without the use of chlorine or other chemicals. Known as the Stereozone Model B, the unit has a capacity of over 1,200 gph. and can be installed on any tank or storage container. For field use, a 250-gal. canvas bag is used. Power is supplied by a 110-volt, 50-60 cycle outlet or by a portable gasoline-electric generator. The sterilizing agent employed is ozone generated by the silent electrical discharge maintained at 11,000 volts. Injected directly into the water passing through the unit, the ozone completely oxidizes bacterial contamination and produces palatable water.

The development of clamps which may be used for ordinary breaks or leaks in cast iron water mains, but which are also designed to be used for repairing mains broken by bombing or sabotage is also an interesting phase of the industry's effort to meet war conditions. At the top of page 133 is a sleeve developed by the *American Cast Iron Company*, of Birmingham, Ala., but not yet placed on the market. The sleeve has been developed to repair water mains broken or blown apart by bombing, and diagrams and engineering details have been sent to representative users for comment before the item is made available for general sale.

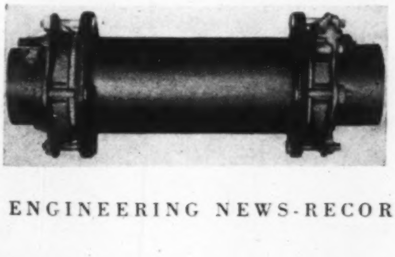
At the bottom of page 133 is a similar bomb crater clamp, developed by the *M. B. Skinner Company*, of South Bend, Ind. Gas and water mains blown apart by bombs may be repaired with this clamp, by placing one end of the clamp on the broken end of the main, and filling the gap which may have been left by bomb action with any random piece of steel pipe, cut to fit the space to be filled.

Another type of pipe repair sleeve, designed originally as a peacetime repair unit, but which may be used in the event of wartime breaks, etc., is shown on p. 134. Developed by the Dresser Mfg. Co., 41 Fisher Ave., Bradford, Pa., this sleeve embodies a new principle of design, and is known as Style 82. The sleeve closes breaks, holes and splits in straight runs of cast-iron pipe without service interruption, by inclosing the defective pipe in a pressure-tight chamber. The sleeve consists of three individual sections, each complete with one side gasket and two end gaskets, assembled in place at the factory. Rectangular rubber compound gaskets fit into a deep recess. The three sections are assembled into a complete sleeve with six side bolts. The three sections used for assembling a complete sleeve may be varied to exactly match the size of pipe to be mended.





Other developments during the past year include a strainer (on p. 134) by *H. A. Brassert & Co.*, 60 East 42nd St., New York, N. Y. Known as the Brassert automatic self-cleaning strainer, the apparatus will remove suspended solids from liquids and dispose of them in continuous, automatic manner. Used either in conjunction with existing equipment, to relieve load on sand filter, etc., or in lieu of settling or baffle tanks, the strainer consists essentially of a rotating drum, fixed to a vertical shaft, centered within a cast iron housing. The entire vertical surface of the drum is drilled with rows of holes, into which is inserted cleaning medium, Solid matter is accumulated on the cleaning disk and



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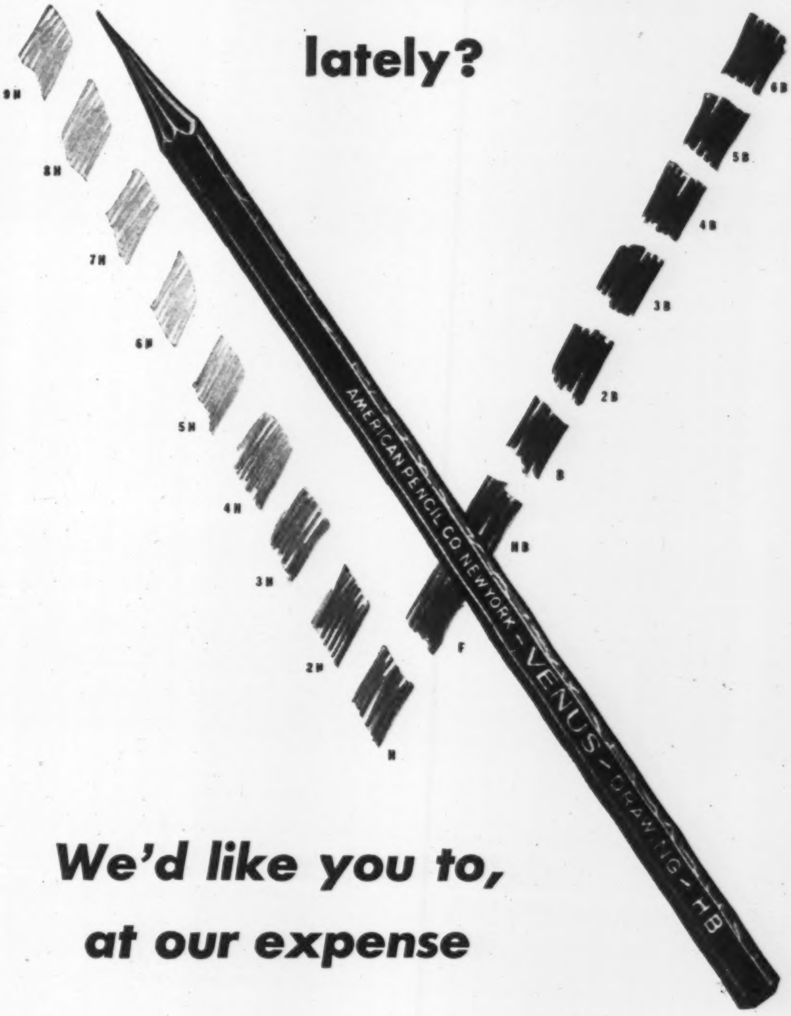
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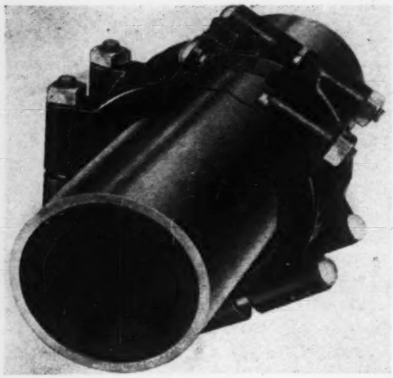
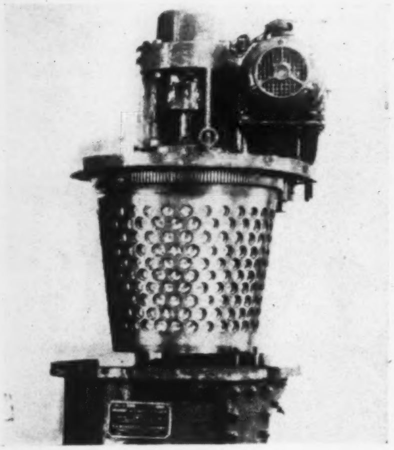


carried by rotation of the drum to the washout slot, where it is flushed out by a reverse flow of cleaning water from inside the drum.



The strainers are built in units capable of handling 24,100 gpm. under pressure not to exceed 250 psi., and are rated for a head loss of about 1½ lb.

Chemical Proportioner

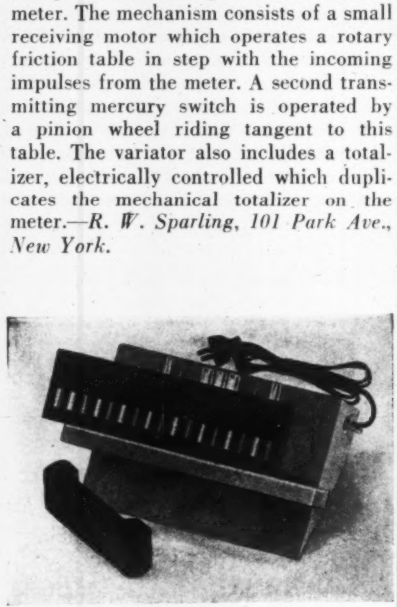
The Graver Chemical Proportioner, a new device providing accurate control of the feed of chemicals into the water treating plant in proportion to the volume of water has been developed. The equipment insures uniform treatment at all times, regardless of the volume of water entering the treating plant. It permits instant increase or reduction of chemical charge over a wide range should water require change of treatment. The apparatus is readily adapted to any make of solution type chemical feeder where swing pipe or skimmer can be installed in chemical feeders.—*Graver Tank & Mfg. Co., Inc., 4089-15 Tod Ave., East Chicago, Ind.*

Butterfly Valve

A recent application of the butterfly valve for emergency duty has been announced by R-S Products Corporation. The feature of this emergency main line shut-off valve is its quick, automatic action. Solenoid operated, the valve provides two-position control in either automatic opening or wedge-tight shut-off. In an open position, the butterfly vane is held open by the magnetic action of the solenoid. On a pump discharge line if the electric power is shut off or fails for any reason, the trigger is tripped and the counterweight closes the butterfly vane wedge-tight against the body of the valve. In the same manner its operation by remote control will shut off a water main or a gas line discharging through a break in the line. It will remain closed until re-set by hand.—*R-S Products Corp., 4530 Germantown Ave., Philadelphia, Penna.*

Variator

The R. W. Sparling Co. has announced the development of a new variator meter, to measure changes of rate of electric impulses. The variator is said to be a convenient instrument for changing the rate of electric impulses from the meter transmitter to a chemical feeder or sampler control circuit. It may be interposed anywhere in the circuit to vary the number of outgoing impulses as required from 20 to 100 per 100 incoming contacts from the meter. The mechanism consists of a small receiving motor which operates a rotary friction table in step with the incoming impulses from the meter. A second transmitting mercury switch is operated by a pinion wheel riding tangent to this table. The variator also includes a totalizer, electrically controlled which duplicates the mechanical totalizer on the meter.—*R. W. Sparling, 101 Park Ave., New York.*



Midget Dalite Lamp

The Taylor Midget Dalite Lamp, designed originally for use with single Taylor slide comparators when colorimetric determinations must be made at night or in dark places, has been found suitable for routine testing even in daylight. The comparator base sits on a shelf at an angle of 45 deg. so that, in making readings, the operator can look

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see full page ad page 135

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TEXAS — Dallas — Shaw Equipment Company
  Houston — McCall Tractor & Equipment Co.
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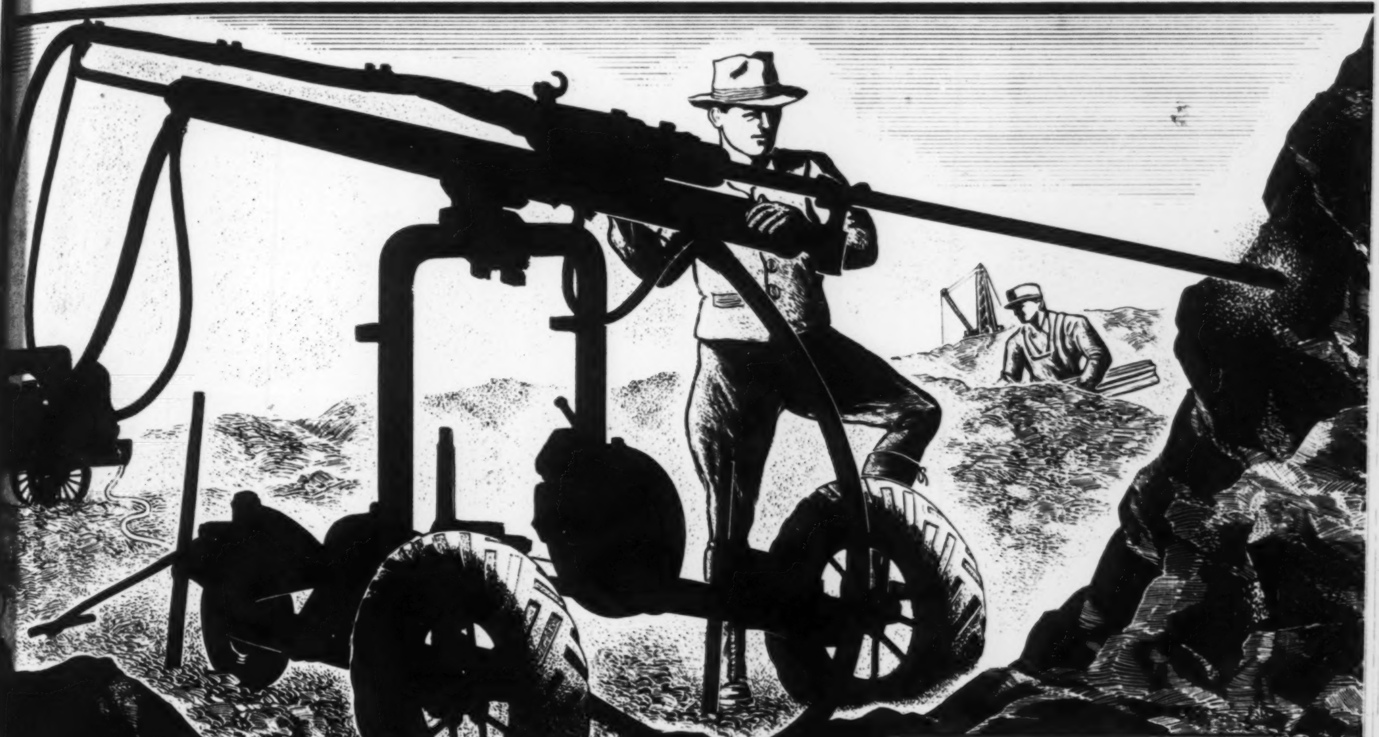
Buy Blue Brutes

Worthington Pump and Machinery Corp.

MORE BRUTE MUSCLE PER POUND



You'll get more punch per pound of air, more staying-power per pound of equipment, with Worthington Blue Brutes in '42!

The rugged "Rockmaster" Wagon Drill (type UPW-35 shown here) is typical of Worthington's complete range of hand-held rock drills, tampers and paving breakers. They're built to *use less air*, and stay on the job longer, at costs surprisingly low!

Smooth, easy-handling strength is characteristic of Worthington's Blue Brute compressors, too. All equipped with Worthington's famous cost-saver — the Feather* Valve . . . they *deliver more air*, at less cost, under the widest range of operating conditions.

Put your men on the job with Blue Brutes, *now!* A trial will prove to them and to you that you get more WORTH from air with Worthington.

Free EQUIPMENT-SAVER

A new EQUIPMENT-SAVER—simple, easy-to-read instructions for tool conservation, ready to post on the job — is yours for the asking! Your nearest distributor, listed on page 134, has reserved yours. If your distributor is not listed, let us send you this free cost-cutting aid to efficient production direct from Holyoke.

* Reg. U. S. Pat. Off.

On the Job with

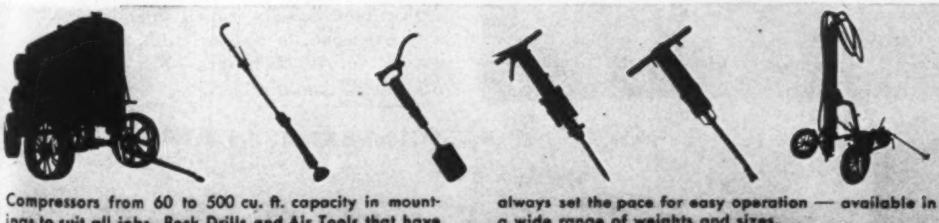
BLUE BRUTES

"5% more holes per day," says this Super. "The Worthington UPW-35 Wagon Drill is easy to set up. Our operators like its 360° U-arm movement in any direction and the new freedom from stuck steels. They like the fact it can drill a toe hole 2 feet below grade. Yesterday, we began drilling shattered rock, but *still* put down more holes per day than with our previous equipment."

On hundreds of Army, Navy, Air Force and Ordnance projects all over the country, Blue Brutes are at work.

Get more WORTH *from air with* WORTHINGTON

BUY BLUE BRUTES



Compressors from 60 to 500 cu. ft. capacity in mountings to suit all jobs. Rock Drills and Air Tools that have always set the pace for easy operation — available in a wide range of weights and sizes.

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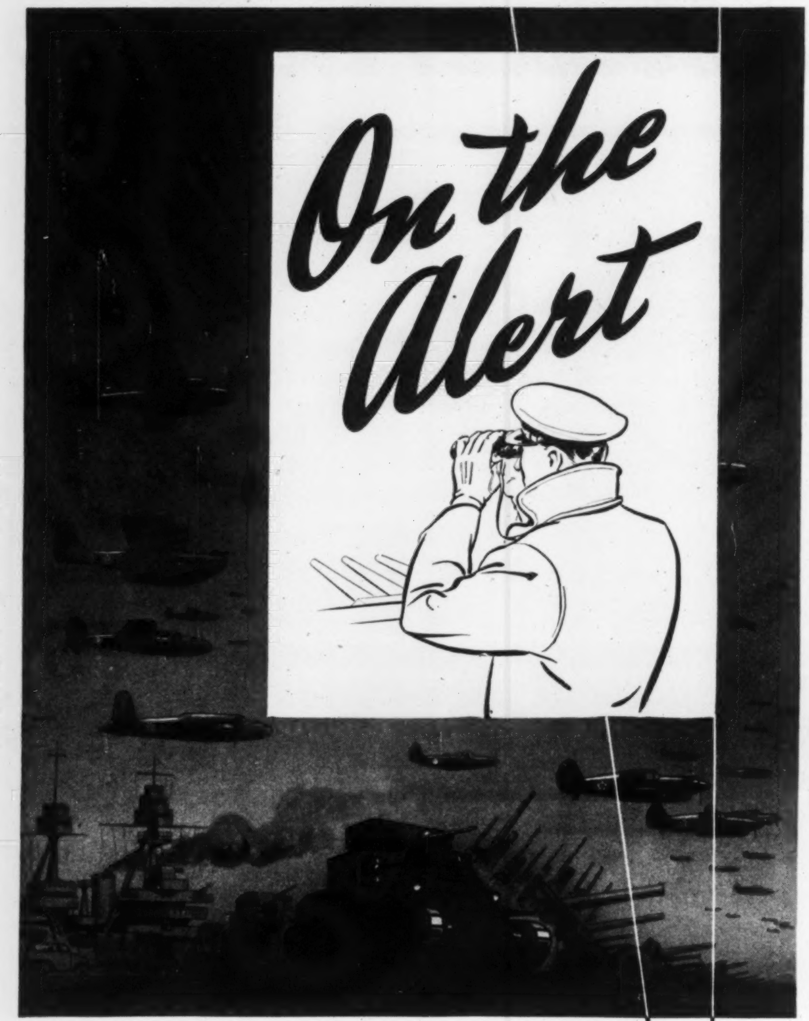
Worthington Pump and Machinery Corporation, Harrison, N. J. Holyoke Compressor and Air Tool Department, Holyoke, Massachusetts

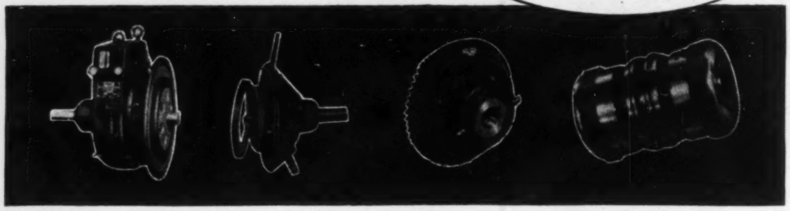


● TO SERVE YOU. Under present conditions, one of the most important services a clutch manufacturer can offer industry is a competent and adequate parts and service organization to assure uninterrupted production, prevent costly delays in waiting for factory shipments of needed parts.

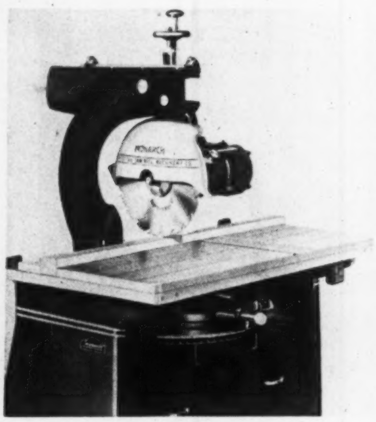
That's why the Twin Disc Clutch Company maintains seven strategically-located, factory-controlled branches and 30 parts and service stations, each with ample stocks of parts. Skilled service men are on call 24 hours a day, constantly "on the alert" to serve you . . . to prevent time-consuming delays due to accident or any other cause.

When in need of parts or service, call your nearest Twin Disc representative. Twin Disc Clutch Company, Racine, Wis.

TWIN DISC
CLUTCHES AND HYDRAULIC DRIVES
REG. U. S. PAT. OFF.



directly into the slots in the slide and base. This eliminates handling the outfit, with possible chance of breakage. Also, in many laboratories and plants it is impossible to obtain a clear daylight background because of walls, trees, etc. The lamp gives uniform daylight conditions at all times. It can be used with any Taylor pH, chlorine or phosphate comparator.—*W. A. Taylor & Co., 7300 York Road, Baltimore, Md.*



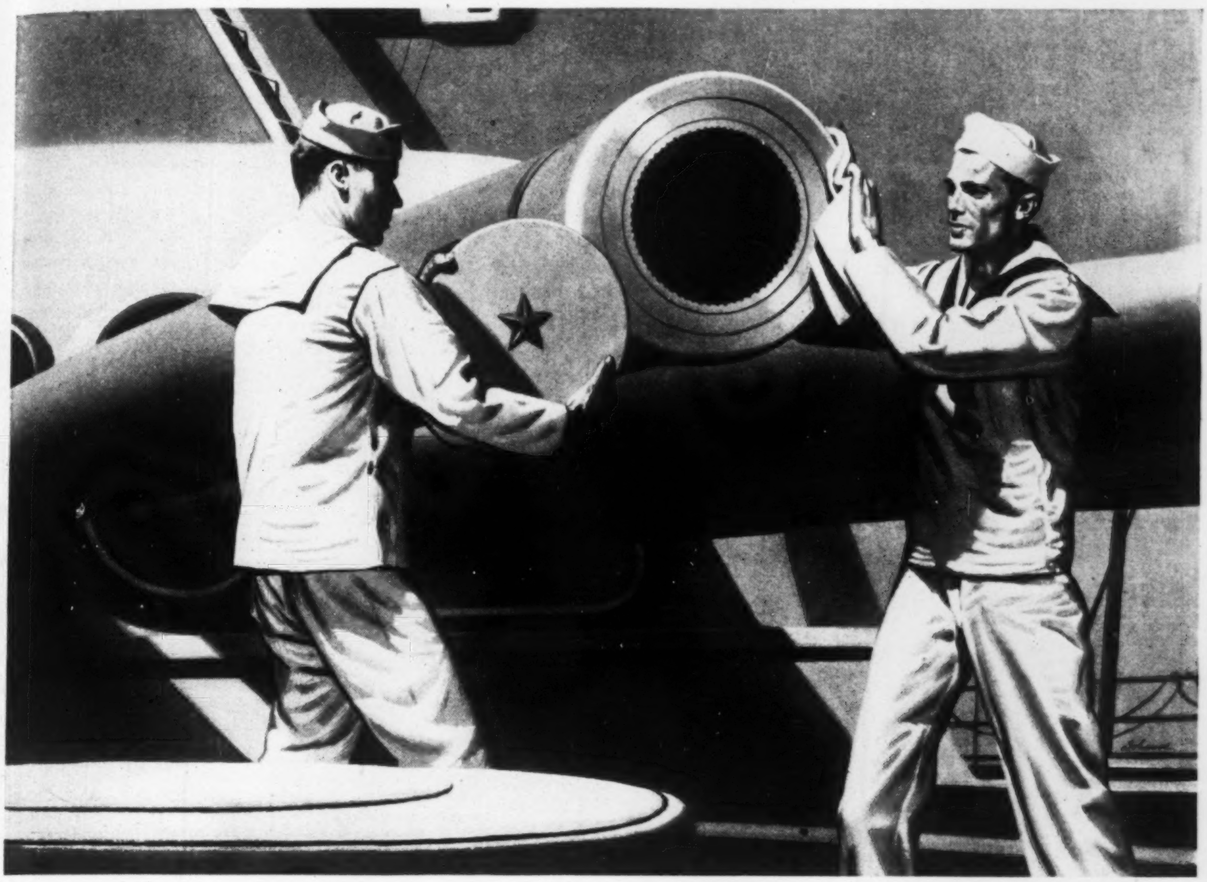
Radial Saw

The American Saw Mill Machinery Co. has announced the new Monarch radial saw "The Streamliner" designed to meet needs of utmost speed and efficiency in production. The machine has a number of new mechanical features which further simplify its operation. Capacity of cross-cutting has been considerably increased in all standard models to take care of the widest panelboard, 32 roller bearings in the ram housing assure light-pressure precision travel of the saw, easy operation and reduction of wear to a minimum. A spring bumper on the ram housing cushions the back stroke and assists in starting the forward motion of the saw. The adjustable crank-feed bar, which mechanically controls the saw travel for heavy dado work and other difficult cuts, is another unique feature.—*The American Saw Mill Machinery Co., Hackettstown, N. J.*

Portable Hopper

A new product, a portable concrete hopper, has been developed by the Butler Bin Co. The hopper may be towed to the job behind an automobile or truck, and on arrival at a job may be detached from the truck, jacked to desired height, and used almost immediately. Use of the machine is said to produce more loads per truck, and has a convertible capacity which enables it, with extension, to be used with 2, 3, 4, and 5 yd. truck mixers.—*The Butler Bin Co., Waukesha, Wis.*

"TO PROVIDE FOR THE COMMON DEFENSE, TO PROMOTE THE GENERAL WELFARE"



Throats to speak our nation's piece

THERE'S A VOICE THAT SPEAKS for the men who stood to their guns at Midway and Wake. It's the don't-tread-on-me roar of an aroused America—given voice by the Navy's big guns!

At cities far from the oceans, in brand-new, Westinghouse-operated factories, will be built much of the Navy's ordnance which will sound our nation's determination to preserve this freedom we have worked so long to build.

Here, in 143 days, plants were built, machines were installed, craftsmen were trained, in an outstanding example of the way Westinghouse "know how" is working three shifts a day for our War Program.

What is this Westinghouse "know how" that brought these plants so rapidly from blueprint to production? It is the hard-earned skill of our craftsmen, trained in the Westinghouse tradition. It is experience and industrial ingenuity. It is the ability to get things done in the best possible way.

The same "know how" that worked for you

Today, the Westinghouse "know how" that once worked for your industry serves the common defense by building parts for tanks and aircraft, binoculars and big guns, and lights for airports.

And this is but a small part of a tremendous effort—as varied as it is huge.

An all-out job for Uncle Sam

Now, many products that once bore the Westinghouse trade-mark must wait. We have a more important job to do . . . the job of speeding the day when our "know how" will once again help you build for a future of peace in a victorious America.

Westinghouse

For the Common Defense

Naval Ordnance
Bomb Fuses
Torpedo Tubes
Military Radio Equipment
Navy Ship Turbines and Gears
Armor-piercing Shot
Lighting Equipment for Air Bases
Army Binoculars
Portable X-ray Units

For the General Welfare

Electric Stairways
Precipitrons
Circuit Breakers
Electric Refrigerators
Wiring Devices
Meters

These lists mention only some of the many thousands of Westinghouse products.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, PITTSBURGH, PENNA.

The **BUDA**
"All Purpose"
JACK

MODEL 2215-S IMPROVED AUTOMATIC-LOWERING RATCHET JACK

Suitable for All Kinds of Construction Jobs
—15 TONS CAPACITY

• This husky Buda "All Purpose" Jack is all that its name implies—it is designed and built to handle the widest possible range of construction lifting jobs, up to 15 ton loads. Here are some of the outstanding features of this new, improved model:

- **Newly designed heavier, wider base assures ample support, greater safety.**
- **5 ft. chain with double hooks extends range of use—ideal for pole pulling, lifting heavy equipment, etc.**
- **Hinged base permits raising and lowering loads vertically or on an angle.**
- **Double lever socket makes lifting easier.**
- **Simple reversing lever operated (without stooping) by pushing with foot or lever bar.**

Write for further details about this and other BUDA *Tested* JACKS!

THE BUDA CO.
Harvey (Chicago Suburb) Ill.

Manufacturer's Activities

Personnel changes and new plans

Gail E. Spain (left) who has been general sales manager for the Caterpillar Tractor Co., of Peoria, Ill., since November 1940, has been appointed a vice-president of the company and will make his new headquarters at San Leandro, Calif., to direct operations there. John Q. McDonald (right) formerly export sales manager, has become general sales manager succeeding Mr. Spain. Mr. McDonald, a Californian, joined "Caterpillar" in 1927 as supervisor of agricultural sales for the western United States and western Canada. J. D. Fletcher, vice-president, will take over direction of export sales.

Norman Thompson, formerly general superintendent of the ore mines for the Republic Steel Corp., Birmingham district, has been appointed assistant general superintendent of the Birmingham division of the corporation.

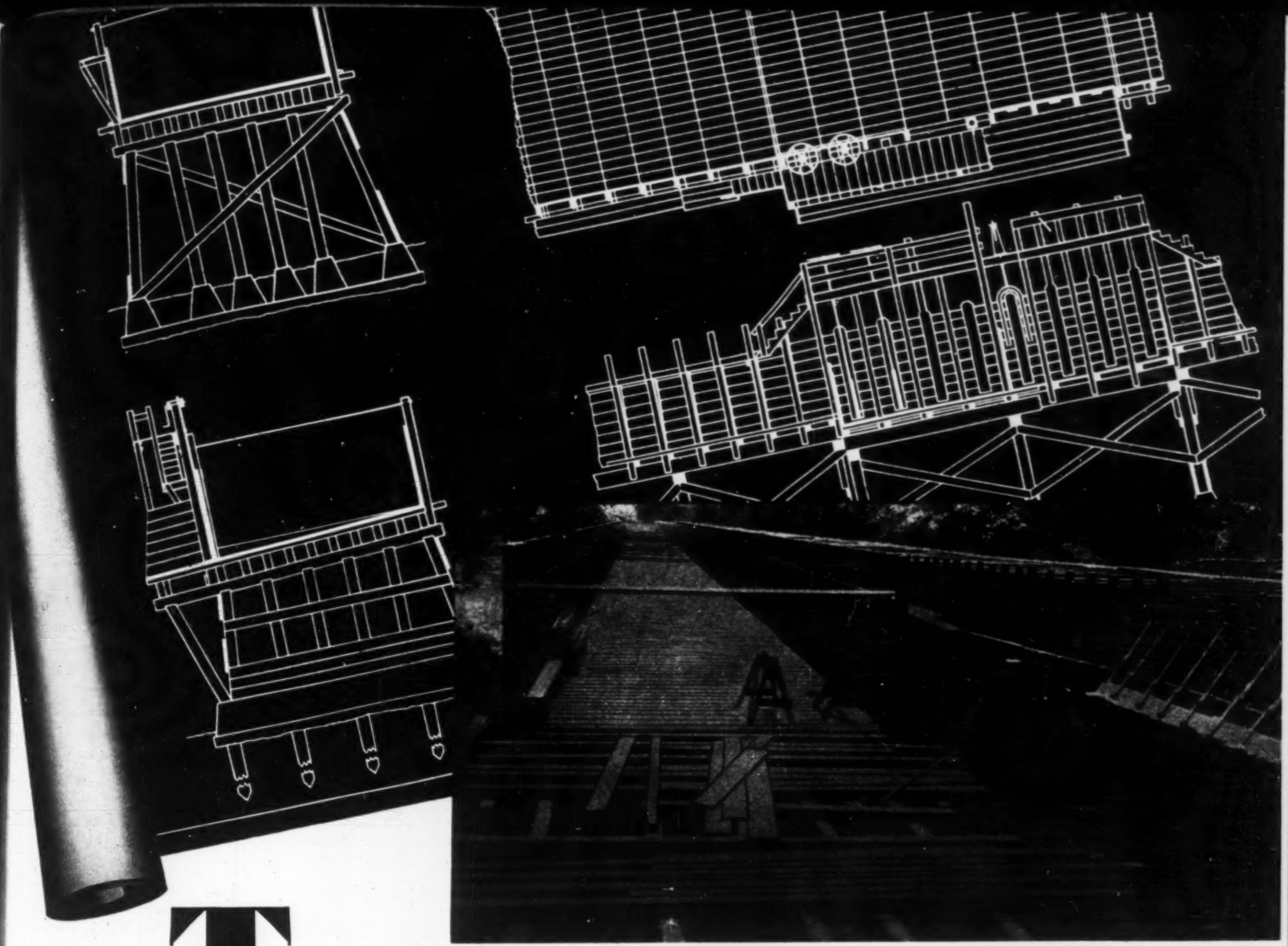
The Westinghouse Electric & Mfg. Co. has announced the election of four of its executives to the rank of vice president. They include L. E. Osborne (left) manager of the steam division and a Westinghouse employee since 1910; and Frank C. Reed (right), president of the Westinghouse Electric Elevator Co. since 1936, a Westinghouse employee since 1903, and credited with many of the large elevator installations throughout the country. Others elected were Andrew H. Phelps, general manager of purchases and traffic and Walter C. Evans, general manager of radio, x-ray and broadcasting. Mr. Phelps joined Westinghouse in '27, Mr. Evans in 1921.

Fred W. Hartmann, assistant district manager in charge of the Chicago waterworks division for Pittsburgh-National Meters, has been granted an indefinite leave of absence to join the armed forces. He was inducted last month into the Corps of Engineers, with the rank of captain.

The Hercules Powder Co. has announced the appointment of William J. Austin, manager of the Chicago office of the explosives department, as Director of Purchases for the company. Mr. Austin succeeds Kurt W. Jappe, former director of purchases, who will become manager of detonator operations, explosives department. Frank W. Roman, assistant manager of the Chicago office of the explosives department, will replace Mr. Austin as manager.

David A. Smith, resident engineer, was on hand last month when the Goodyear Tire & Rubber Co. opened its new addition to its Chemigum plant in Akron, Ohio. Three individual synthetic rubber production lines have been installed in the new addition to provide for uninterrupted service. Still another government-sponsored addition is scheduled for completion at this plant later this year.

B. C. "Mike" Briody has been appointed field engineer for Keystone Asphalt Products Co. Briody, former vice-president in charge of the highway division of Truscon Steel Co., has been in the construction field for 32 years. He pioneered the original steel longitudinal joint for concrete road and airport runway construction, and in his new capacity will work with the construction engineers in introducing the new Keystone center-strip and other Keystone construction products. He will make headquarters at Chicago.



Thaw-out "frozen" construction with PRESSURE-TREATED WOOD

Shortages of certain materials are halting a number of projects not directly connected with war effort, but still highly important to the welfare of entire communities, and to the continued operation of various "supporting" industries.

Pressure-treated wood is helping engineers to complete such projects.

The use of pressure-treated wood mitigates construction delays. It conserves the nation's supply of critical metals. Structural members can be preframed to blue-print, and easily assembled with local labor and equipment. Savings in time and cost, as compared to other permanent construction, frequently run 50% or more. And further savings are realized because the dependability of pressure-treated wood is more than "skin-deep"; periodical painting is not required for protection.

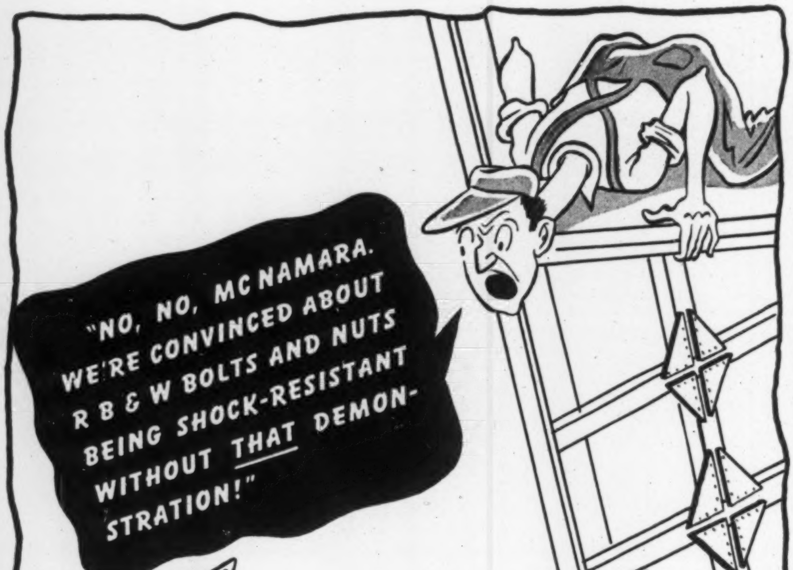
The present wide-spread use of pressure-treated wood is not just a war development. It has been first-choice for years with many engineers, who based their selection on its proven permanence and economy. The illustration shows one such application in a western state. (*) This flume, completed in 1927, was reported by municipal authorities as "good as new" after 15 years on the job. The old flume on the right, built of *un*-treated material, was rebuilt first after only 12 years . . . and has, through continuous repairs, been replaced an estimated one or more times since.

If some of *your* projects are "frozen," pressure-treated wood can probably thaw them out for you. We will be glad to give you full information, if you will write.

(*) (To eliminate the most remote possibility of any helpful information reaching enemy hands, we are omitting location.)

WOOD PRESERVING DIVISION
KOPPERS COMPANY
PITTSBURGH · PENNSYLVANIA

use **KOPPERS** *products*



"NO, NO, MC NAMARA. WE'RE CONVINCED ABOUT R B & W BOLTS AND NUTS BEING SHOCK-RESISTANT WITHOUT THAT DEMONSTRATION!"

Use R B & W Bolts and Nuts . . .

Quick-starting, quick-tightening because they are accurately, uniformly sized and threaded — and carefully inspected.

Vibration-resisting, shock-resisting because the manufacturing method insures extra strength, and all processing is controlled from raw rod to finished product.

EMPIRE BOLTS NUTS-RIVETS AND ALLIED FASTENING PRODUCTS . . . SINCE 1845

RB&W *Making strong the things that make America strong*

Russell, Burdsall & Ward Bolt and Nut Company. *Factories at* Port Chester, N. Y., Rock Falls, Ill., Coraopolis, Pa.; *sales offices at* Philadelphia, Chicago, Detroit, Chattanooga, Los Angeles, San Francisco, Portland, Seattle

MEN AND JOBS

A. J. Fox is project manager for the construction of buildings for an Air Force Training School near Goldsboro, N. C.

Alan P. Sloan, of Columbia, S. C., sales manager for the Jeff Hunt Road Machinery Co., has been commissioned as captain in the Corps of Engineers and assigned to the district office at Atlanta, Ga.

Adolphus Mitchell, senior traffic engineer of the North Carolina State Highway and Public Works Commission, has been granted a leave of absence to do special work in connection with traffic conditions at a North Carolina marine airbase.

Norman R. Sack, bridge engineer for the Missouri state highway department, has been assigned as project engineer with Everdrup and Parcel, St. Louis, Mo., who hold contracts for work near Fort Norman and White Horse in northwestern Canada.

H. M. Sparks, of Mitchell, S. D., has been commissioned a Major in the Corps of Engineers.

M. E. Chamberlin, city engineer for Montevideo, Minn., for the past 21 years, has been granted a leave of absence to accept a defense project position in Montana.

George W. Diebler, of Duluth, Minn., has been reappointed county engineer for St. Louis county for a second term.

C. W. Muhlenbruch, instructor in the department of civil engineering at Carnegie Institute of Technology, has been promoted to assistant professor of civil engineering in that school.

E. W. Dunn, district engineer at Sioux City, Iowa, for the Iowa highway commission, has been granted a leave of absence to be in charge of construction on a defense plant near Sioux Falls, S. D.

O. N. Floyd, Dallas, Tex., engineer, has been named consulting engineer on a rehabilitation project on Randell Lake dam, near Denison.

Fred C. Taylor, director of the Michigan state highway department's planning and traffic division, has accepted an appointment as transportation consultant to the War Department, and will report for duty in Washington, D. C. He will continue in an advisory capacity with the state highway department, while

CUMMINS
Dependable
DIESELS

the contractor's *dependable* ally

Because every big job is merely the sum of many small jobs . . . the success of the big job depends upon the efficiency with which the small jobs are done . . . the competence of the men and their allied equipment. America has a big job to do. Ultimate success depends upon the speed and economy with which each one does his own particular job.

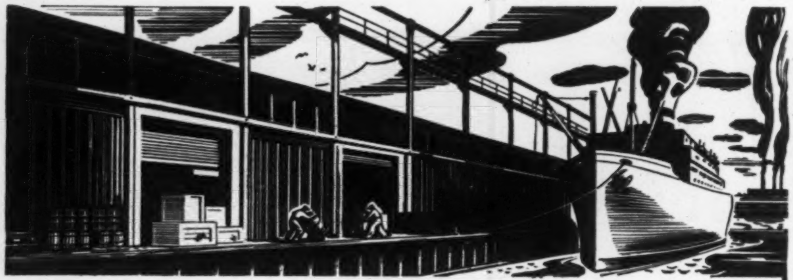
Take construction, for example: The speed and economy with which big dirt moving jobs are completed depend upon the reliable performance of the allied equipment: tractors, shovels, dump trucks, pumps and compressors, etc.

The main reason you find nationally-known contractors specifying Cummins Dependable Diesel power is because of its proved dependability. Valuable time is not lost in tedious starting. The Cummins Diesel answers the first touch of the starter . . . no need for an advance crew to start the engines to be sure they are ready for the day's work. The day-after-day steady plugging with few interruptions for service has given the Cummins Diesel a permanent place in all types of power driven road machinery and dirt-moving equipment.

The Cummins Diesel is the contractor's dependable ally. That's why you find so many of these important, huge dirt-moving projects finished "ahead of schedule." Cummins Engine Company, Columbus, Indiana.

Model HBS-600 (supercharged) Cummins Dependable Diesel. 200 hp. at 1800 rpm.

Kramp Construction Company of Milwaukee used this Cummins Diesel-powered Heil Hi-Speed Cable Scoop on the re-location of Milwaukee County Highway 100.



Millions of Feet Say "This Wood Adds Long Life"

DOCKS AND PIERS and boardwalks—wood that has demonstrated its durability on such jobs will give you lasting economical construction. Wolmanized Lumber* is that kind of wood. Examination of ocean-front installations employing millions of feet of this long-lived lumber for superstructures—some of it put there fifteen years ago—proves this.

WOLMANIZED LUMBER gives you this plus value without sacrificing the other very desirable advantages of wood construction: lower first cost, ease of handling and erection, light weight, strength, resilience. It is clean, odorless, and it can be painted.

VACUUM-PRESSURE impregnation with Wolman Salts* preservative makes Wolmanized Lumber highly resistant to decay and termite attack. "Fibre fixation" prevents leaching or washing out of the preservative. The treated wood does not corrode spikes, bolts and metal fittings. Control of impregnating processes in Wolmanizing plants by one central laboratory insures a uniformly high-grade product.

WOLMANIZED LUMBER may be the key to faster construction schedules on your structures, and long life for postwar use. May we send you data? Write American Lumber & Treating Company, 1649 McCormick Building, Chicago, Illinois.

*Registered Trade Mark

WOLMANIZED LUMBER

WOLMANIZED
A. L. & T. CO.

Carl McMonagle, of Lansing, now assistant to Taylor, will take over supervision of the division.

C. M. Rose, formerly resident engineer for the California state highway commission at Vallejo, Cal., is now a superintendent for Barrett & Hilp Co. on paving work at Mare Island naval base.

Ralph D. Stout has resigned his post as Guilford County (N. C.) engineer and assistant tax supervisor, to become associated with the Southern Mapping & Engineering Co. at Greensboro.

Daniel V. Terrell has been appointed assistant dean of the engineering college of the University of Kentucky to succeed the late W. E. Freeman.

Sarto Plamondon, has been appointed engineer in the division of industrial hygiene of the Department of Health of the Province of Quebec.

Maj. J. P. Carrière of the Royal Canadian Engineers, has recently returned from duty overseas to attend the Staff College at Kingston, Ont. Before entering active service, Major Carrière was senior assistant engineer in the Montreal office of the Department of Public Works of Canada.

T. W. Ellis has been reappointed superintendent of public works for the city of Henderson, N. C.

Ronald G. Archer, formerly assistant engineer of the Works Department of the City of Toronto, Ont., has been commissioned as a flying officer in the Royal Canadian Air Force.

Raymond Leary, formerly an engineering employee of the sewerage commission of the city of Milwaukee, has resigned to join the J. Donohue Co. of Sheboygan, to work at the Milwaukee Ordnance Plant.

Hugo B. R. Craig, formerly of the Hydro-Electric Power Commission of Ontario, has joined the staff of the Fraser-Brace Engineering Co. Ltd., of Montreal.

M. S. Gwinn, senior engineer in the supplementary roads bureau of the Missouri Highway Department, has been made acting director of the state-wide highway planning survey office, replacing **Capt. John H. Long,** recently called to active Army service. **V. W. Enslow** will be acting engineer in charge of the bridge bureau for the department, and **O. B. Chrisman,** senior engineer in the bureau of construction, has been made acting division engineer of Division 8 at Springfield.

FOR MODERN WAR PLANT CONSTRUCTION...

MAHON
ROLLING STEEL
DOORS

Greater Security . . . FOR OPENINGS ON INSIDE WALLS AS WELL AS OUTSIDE DOORWAYS

THAT Mahon Rolling Steel Doors, for *exterior* openings, provide the greatest possible protection from fire and intrusion is well established in the minds of architects and building engineers responsible for completion of the present enormous industrial building program . . . and by the experience of thousands of plant owners where these doors are now in almost constant service, day and night.

It is equally important that this same protection be assured for the openings on *inside* walls (interior partitions, dividing fire walls, corridor walls, elevator shafts, etc.) Under present war production conditions, fire and damage hazards are increasingly greater.

Frequently, too, it is essential that certain departments be kept segregated, without interfering with the inter-department movement of materials and authorized employees.

The practical answer is either Mahon *non-labeled* Doors or Mahon Underwriters' *labeled* Doors, for automatic closing in the event of fire. Mahon engineers will gladly assist you in the planning of any construction project and furnish you estimates—promptly. The new Mahon Rolling Steel Door catalog—or Sweet's—describes in detail the many improvements and advantages of Mahon construction and operation. If you haven't a copy, send for one today.

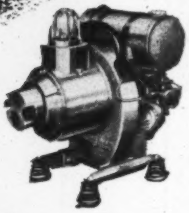
Manufacturers of Steel Roof Deck, Rolling Steel Doors, Shutters and Grilles, Kalamein Doors, Tin Clad Doors, Cast Iron Roof Sumps and Roof Sump Recesses.

THE R. C. MAHON COMPANY • DETROIT • CHICAGO

★ ★ **MAHON** ★

Use Them For All They Are Worth

HOMELITE Portable Generators & Pumps



Don't leave your Homelite Generators and Pumps loafing around in your tool box. Essential buildings must go up fast and Homelites can certainly help. Use your Homelite Generators not only for floodlighting night work but also for operating electric hand tools. They generate plenty of power—1800 watts—enough to operate several hand tools as well as brilliant floodlamps.

And with your Homelite Pumps—use them for dewatering your excavations, then leave them in operation to prevent seepage from accumulating. Homelite Pumps are completely self-priming. They handle seepage automatically. Require no manual attention.

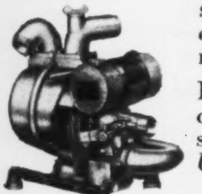
Homelite Pumps and Generators are built for rugged continuous service—in spite of their small compact size. Use them as much or as often as you want. *Use them for all they are worth.*

★ Keep 'em in Good Condition

- Keep the built-in engine free of carbon.
- Keep the spark plugs in good condition.
- Don't use the choke for a throttle.
- Mix ½ to ¾ pt. of oil with each gallon of gasoline used.
- Keep the carburetor set on the lean side.

Send for free service manuals—specify model and serial numbers of your Homelite units.

HOMELITE CORPORATION
2906 RIVERDALE AVENUE, PORT CHESTER, NEW YORK



MEETINGS

American Water Works Association, Stevens Hotel, Chicago, June 21–25.

Society for the Promotion of Engineering Education, 50th annual meeting, Columbia University, New York City, June 29–July 2.

American Society of Civil Engineers, annual convention, University of Minnesota, Minneapolis, Minn., July 22–23.

Regional and Local Meetings

Eastern Photoelasticity Conference, 15th semi-annual meeting, University Club, 40 Trinity Place, Boston, Mass., June 20.

Montana Association of County Commissioners, Missoula, Mont., June 23–24.

Pennsylvania Sewage Works Association, annual conference, Carlisle Sewage Treatment Plant, Carlisle, Pa., and Penn-Harris Hotel, Harrisburg, Pa., August 25–26.

Pennsylvania Water Works Operators' Association, annual meeting, Penn-Harris Hotel, Harrisburg, Pa., August 27.

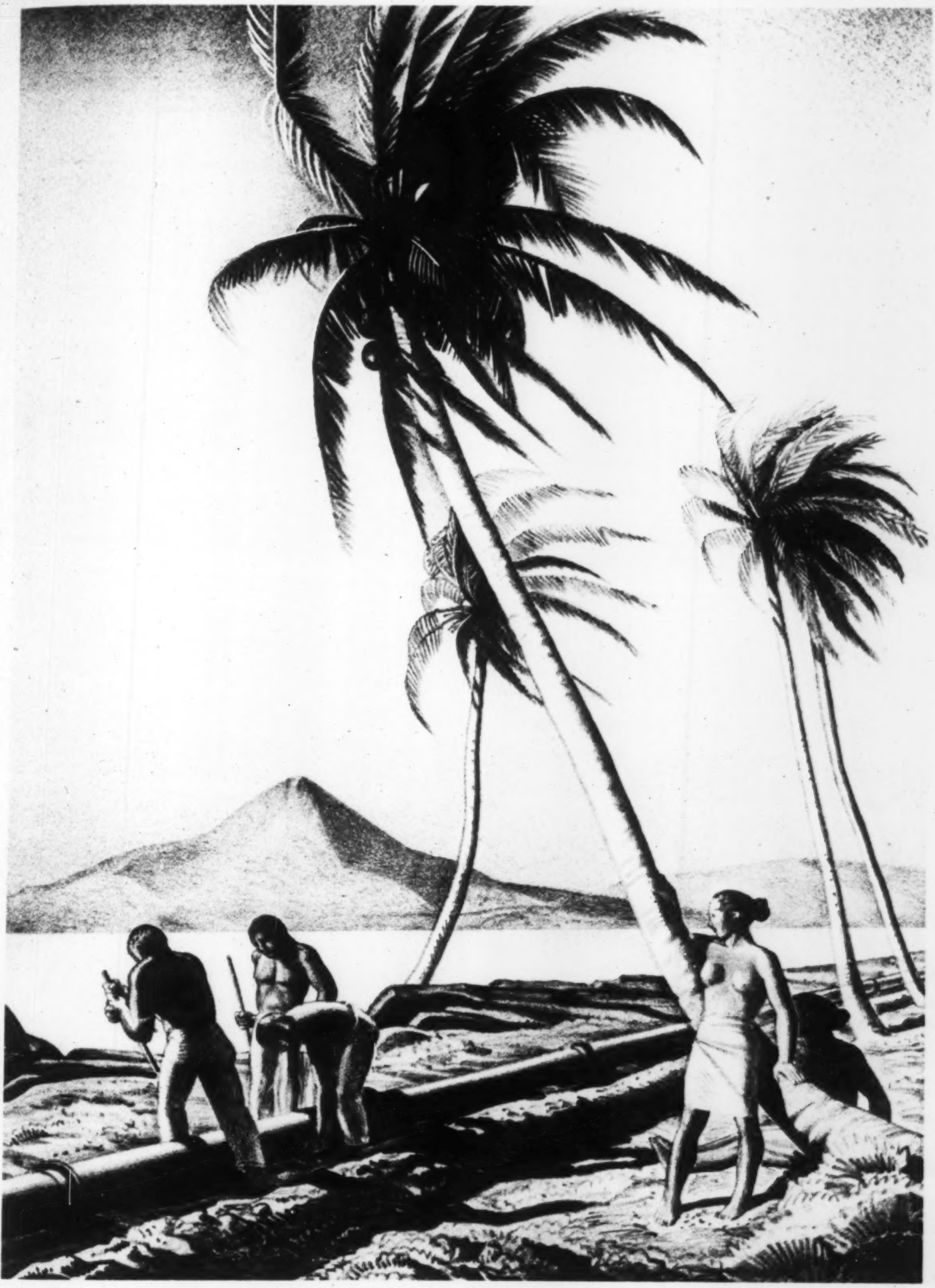
Elections and Activities

A. C. Blomgren, superintendent of airways for the Civil Aeronautics Administration, was elected president of the Fort Worth branch of the American Society of Civil Engineers at a recent luncheon meeting. C. J. Harkrider was elected vice president and D. W. Robinson was made secretary-treasurer.

New officers of the Montana section of the American Water Works Association are F. F. Palmer, city engineer of Forsyth, chairman; S. R. Young, water superintendent, of Hardin, vice chairman; John Hall, of Fort Shaw, A. E. Heath of Billings, trustees.

David R. Smith, city engineer and director of public works of St. John, N. B., has been elected chairman of the St. John branch of the Engineering Institute of Canada.

John Macklin of Madison was elected president of the Wisconsin Sewage Works Operators Association at the annual meeting held recently. R. W. Frazier of Oshkosh was elected first vice president; Fred Comstock of Brandon, sec-



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UNITED STATES PIPE AND FOUNDRY COMPANY

BURLINGTON, NEW JERSEY

America's Largest Producer of Cast Iron Pipe for

Water, Gas, Sewerage, Drainage and Industrial Service

* This illustration shows the "Ring Test" to determine the modulus of rupture. A ring cut from the pipe is subjected to progressively increased crushing load until failure occurs. Although not a required acceptance test, it is one of the additional tests regularly made by this Company to further check and maintain the quality of its pipe so that it will adequately meet severe service requirements.

*** One of a series of controls in operation at each of our plants, beginning with inspection and analysis of raw materials and ending with tests of the finished product, all subject to the central control of our headquarters staff at Burlington.**

U.S.
cast iron
PIPE

Centrifugally or Pit Cast for
water, gas, sewerage, drainage
and industrial services.

ond vice president, and T. F. Wisniewski of Green Bay, secretary-treasurer.

C. C. Davis, of Wilmington, N. C., was elected president of the North Carolina Association of Plumbing and Heating Contractors at the group's 32nd annual convention at Asheville recently.

Two hundred members of the Illinois Road Builders Association gathered at their annual spring meeting at the Drake Hotel in Chicago recently, to query government experts on regulations that affect the road building industry. One of the principal guests was Capt. R. D. Spalding, public works officer, Great Lakes Naval Station, who reported generally on the progress of construction at Great Lakes. A board of experts, representing government agencies, included Donald Booz and Alfred Petschaft of Washington, chief and senior attorney, respectively, of the machinery division, OPA; Edmund H. Eitel and Earle S. Heffley of Chicago, War Production Board, and R. H. Harrison, a regional engineer of the PRA.

At an annual meeting of the dominion council of the Association of Professional Engineers of Canada, held for three days at St. John, N. B., a resolution was passed urging that a party of Polish engineers now working in Canada be licensed. The matter was introduced by M. B. Watson, of Toronto, secretary of the association, who revealed that a number of the Polish engineers had been brought to the dominion from England, in a three-way agreement between the Canadian, British and Polish governments. W. P. Dobson, of Toronto, was elected president, succeeding D. A. R. McCannel, of Regina; vice-president elected at the meeting was P. Burke-Gaffney, of Winnipeg; reelected secretary was M. B. Watson, of Toronto. The delegates were given a luncheon by the St. John branch of the Engineering Institute of Canada, and the Association of Professional Engineers of New Brunswick, jointly.

The June meeting of the Georgia section, American Society of Civil Engineers, was held at Atlanta, where members discussed proposed membership drive, activities of the Georgia Tech Student Chapter, a proposed drive to start an engineer corps unit in the R.O.T.C. at Georgia Tech, and civilian defense activities.

H. W. Schrieber was elected president of the Wisconsin chapter, American Society of Heating & Ventilating Engineers, at the group annual meeting held in Milwaukee. Other officers chosen were: F. W. Goldsmith, vice-president; O. A. Trostel, treasurer; C. S. Baker, secretary; T. M. Hughes, C. W. Miller, and C. H. Randolph, directors.

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ADAPTABLE
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REX-WELD
flexible Metal hose
Both Steel and Bronze

The Immediate Solution to Your Flexible Connection Problems!

Type RW-81
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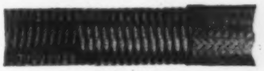

Type RW-91
(helical corrugations)

REX-WELD (corrugated) Flexible METAL Hose

Sizes from 1/8" I. D. to 4" I. D. inc. Pressures to 14,500 p.s.i. Temperatures to 1000° F. One-piece, all-metal construction. Continuous lengths to 50 feet.

Rex-Tite Mechanical (Re-attachable) couplings; solder couplings; brazed and welded couplings and flange assemblies for Rex-Weld Flexible Metal Hose. *Complete data on request.*

Use our production capacity to increase your production

CHICAGO METAL HOSE CORPORATION
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A SPECIAL "TRUCK-SAVING SERVICE"

For FIGHTERS ON THE HOME FRONT

GMC VICTORY MAINTENANCE KEEPS YOUR TRUCK ON THE JOB

The Army calls truck servicing "Motor Maintenance." GMC calls its war-time service program "Victory Maintenance." Both are important because commercial trucks that work behind the lines hauling food, merchandise or war materials are as vital to victory as Army trucks that pull guns or transport troops. Your nearest GMC dealer will be glad to show you how "Victory Maintenance" can prolong the life of your truck . . . increase its economy . . . restore its performance . . . keep it "pulling for victory" for the duration!

Special "Service Payment Plan" available through our own YMAC

THE TRUCK OF VALUE

GMC TRUCKS

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NEW PUBLICATIONS

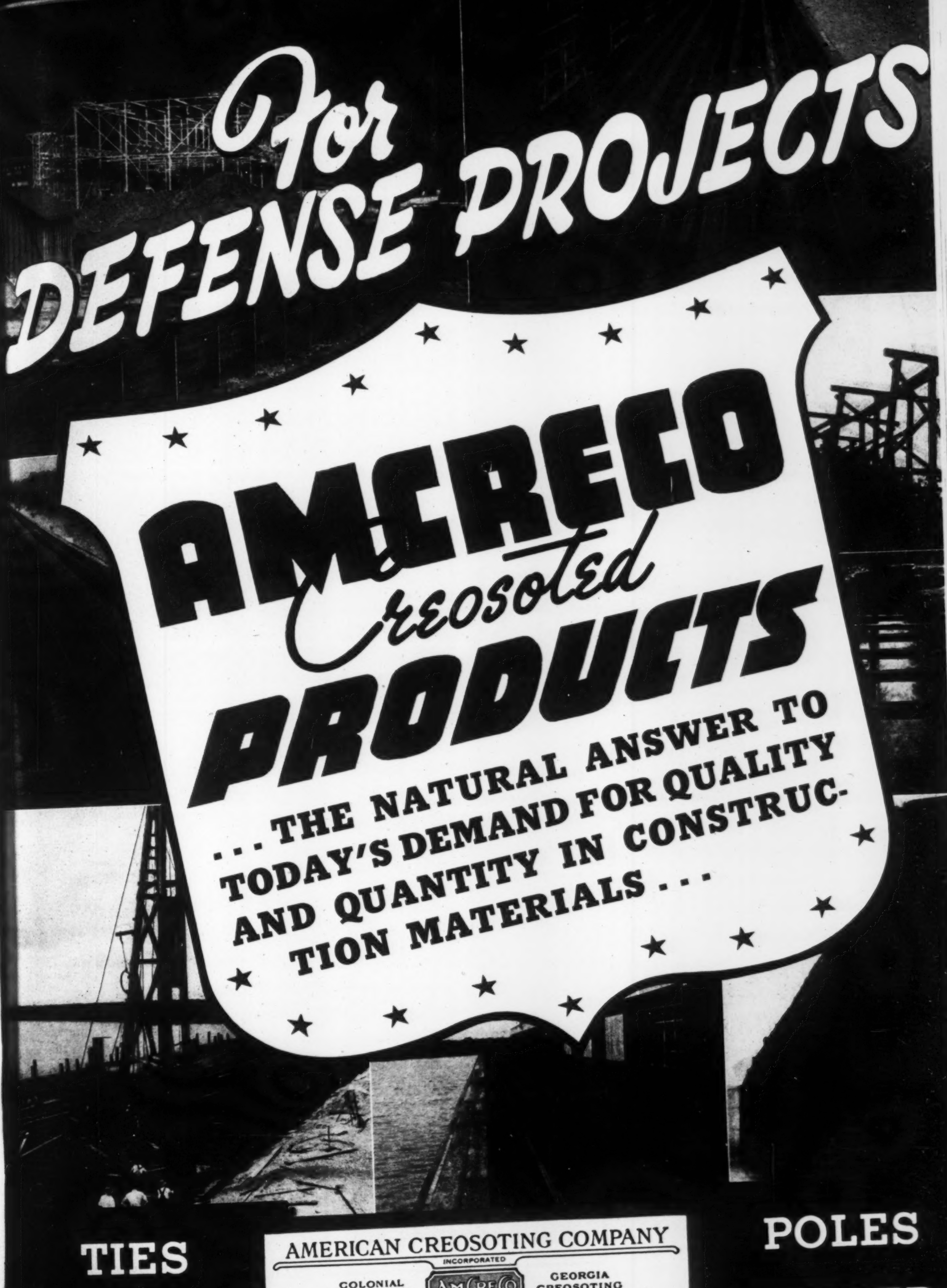
Design—First of a new series of booklets to be distributed under the general title of "New Departure Engineering Service," and now immediately available is "Details of Design of Shafts and Housings for Ball Bearings." Written for the benefit of the machine designer interested in applying ball bearings, this very helpful volume includes such subjects as proportions and finish of bearing seats; locknut threads, recommended shaft shoulders; designing to aid disassembly, locating and clamping methods and the use of adapter sleeves. Each subject is well illustrated.—*Advertising department, New Departure, Bristol, Conn.*

Arc Welding—The "Fleet-Fillet" technique of arc welding, which permits up to 100 percent faster fillet welding and which will, thus, greatly speed up production of welded ships, tanks, guns and other war-vital products, is described and illustrated in a new bulletin published by the Lincoln Electric Co. The booklet contains 18 pages and 36 illustrations, including photographs and line drawings. Planned as ready reference material for plant production officials, welding operators and all others concerned with welding, the bulletin is concisely written.—*The Lincoln Electric Co., Cleveland, Ohio.*

Catalog—The new Taylor Pressure Instrument Catalog No. 76JF, describes the bourdon spring, bellows and manometer type instruments for indicating, recording and controlling pressures. Latest information on gage, differential and absolute pressure and vacuums can be found in this comprehensive catalog. Also listed are the Taylor indicating mercury gages for absolute pressures and vacuums, as well as complete information on Taylor charts for pressure recorders and controllers.—*The Taylor Instrument Companies, Rochester, N. Y.*

Rubber—The B. F. Goodrich Co. has issued one of its most timely volumes for industrial executives, entitled "Care and Maintenance of Conveyor and Elevator Belting." Consisting of 24 pages, the catalog is packed with vitally important instructions for the care and maintenance of belting, as well as chapters containing a wide range of belt data, valuable when considering installation or repair problems.—*The B. F. Goodrich Co., Akron, Ohio.*

Sparks—The first issue of a quarterly magazine, "Sparks," has been brought out by Tube-Turns. Well illustrated, the issue stresses the importance of welding in the war effort.—*Tube-Turns, Inc., Louisville, Ky.*



For DEFENSE PROJECTS

AMCRECO Creosoted PRODUCTS

... THE NATURAL ANSWER TO TODAY'S DEMAND FOR QUALITY AND QUANTITY IN CONSTRUCTION MATERIALS ...

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ADDRESS INQUIRIES TO CHICAGO, ILL., OR LOUISVILLE, KY.

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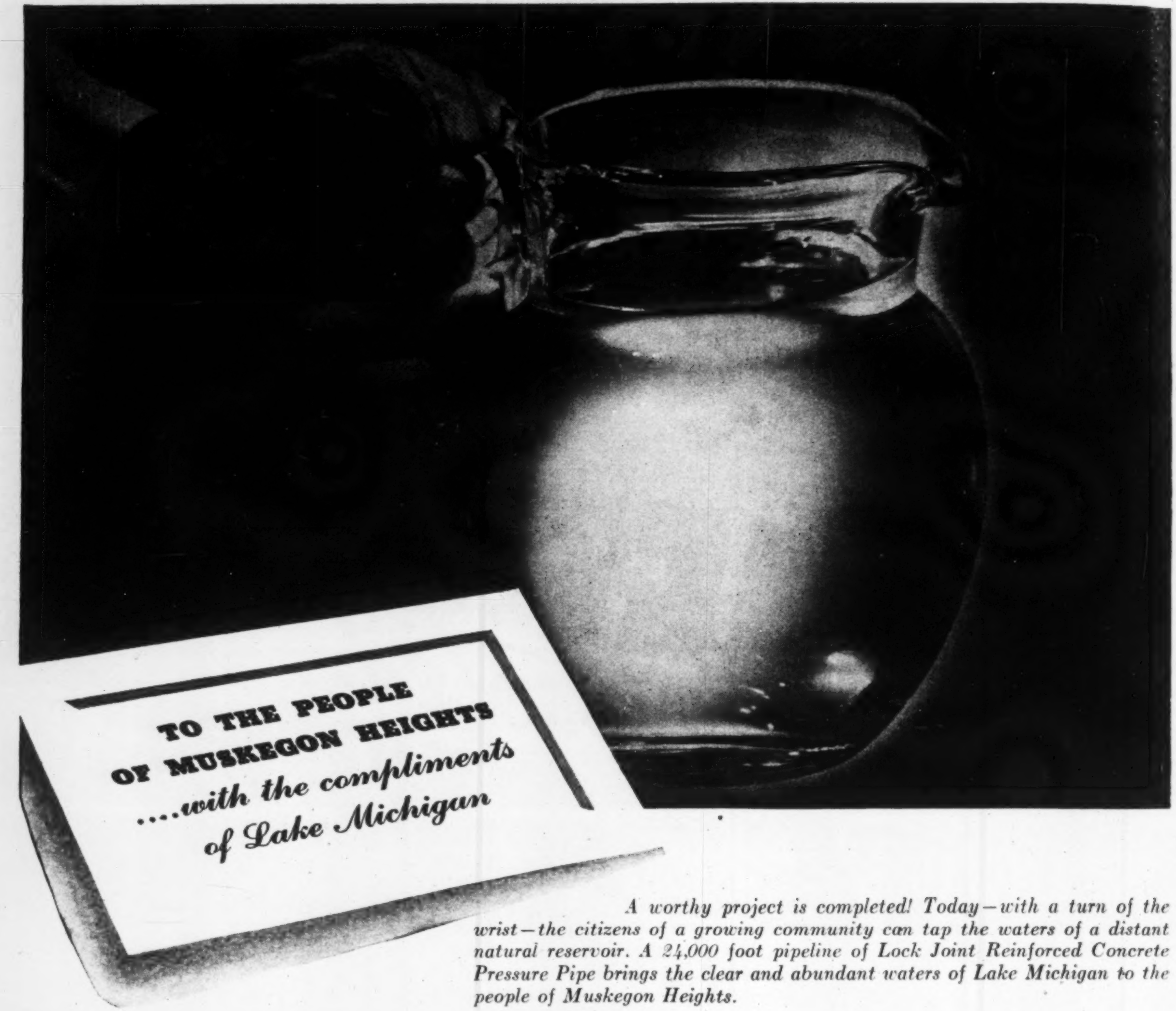

A worthy project is completed! Today—with a turn of the wrist—the citizens of a growing community can tap the waters of a distant natural reservoir. A 24,000 foot pipeline of Lock Joint Reinforced Concrete Pressure Pipe brings the clear and abundant waters of Lake Michigan to the people of Muskegon Heights.

In planning a pressure pipeline these days it is the duty of responsible officials to specify strength and durability and to ensure speed of installation and economy of those materials essential to our War Effort. Lock Joint Reinforced Concrete Pressure Pipe has proven its lasting qualities over a long period of years and under all conditions of service. Today, large manufacturing capacity, ease of installation, and designs which permit the greatest economy of steel, make Lock Joint Concrete Pipe the ideal construction for Water Supply, Sewers, Storm Drains and Culverts.

Lock Joint Pipe Company stands ready to serve you and your Community. Whether your project is large or small, your telephone call, telegram, cable or letter to any of our offices will bring a prompt response—and will result in an immediate and satisfactory solution to your problem.

SCOPE OF SERVICES

Lock Joint Pipe Company specializes in the manufacture and installation of Reinforced Concrete Pressure Pipe for Water Supply Mains as well as Concrete Pipe of all types for Sanitary Sewers, Storm Drains, Culverts and Subaqueous lines.

LOCK JOINT
Reinforced Concrete
PRESSURE PIPE

LOCK JOINT PIPE COMPANY
Established 1905
AMPERE • NEW JERSEY
Denver, Colo. • Chicago, Ill.
Kenilworth, N. J. • Kansas City, Mo.
Rock Island, Ill. • White Plains, N. Y.
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Hartford, Conn. • Navarre, Ohio

ROSTER OF

Waterworks Products & Services

CLASSIFIED BY PRODUCTS

COMPANY NAMES, ADDRESSES, TRADE NAMES

Products are indexed by noun or principal word—
Construction equipment is not included in this directory ★

Abrasives

Aloxite—See Carborundum Co.
Alundum—See Norton Co.
Carborundum Co., Niagara Falls, N. Y. "Aloxite"
Cortland Emery Aggregate—See Maguire Co., Inc., Walter
Crystolon—See Norton Co.
Maguire Co., Inc., Walter, 330 W. 42 St., New York, N. Y. "Cortland Emery Aggregate"
Norton Co., 1 New Bond St., Worcester, Mass. "Alundum" "Crystolon"

Aerators

Aer-o-mix—See Vogt Mfg. Co.
Aloxite—See Carborundum Co.
Alundum—See Norton Co.
American Water Softener Co., Inc., Lehigh Ave. & Fourth St., Philadelphia, Pa.
Bacharach & Co., E. W., Rialto Bldg., Kansas Citiy, Mo.
Carborundum Co., Niagara Falls, N. Y. (Diffuser Plates) "Aloxite"
Carter Co., Ralph B., 192 Atlantic Ave., Hackensack, N. J. (Paddle)
Chain Belt Co., 1600 W. Bruce St., Milwaukee, Wis.
Chicago Pump Co., 2336 Wolfram St., Chicago, Ill.
Cochrane Corp., 17th St. & Allegheny Ave., Philadelphia, Pa.
Electro Refractories & Alloys Corp., 662 Andrews Bldg., Buffalo, N. Y. (Diffuser Plates)
Graver Tank & Mfg. Co., 4809 Todd Ave., East Chicago, Ind. (Mechanical)
Infilco, Inc., 325 W. 25th Pl., Chicago, Ill. (Nozzle)
King Ventilating Co., Owatonna, Minn.
Link-Belt Co., 2045 W. Hunting Park Ave., Philadelphia, Pa.
Municipal Service Co., 532 Dwight Bldg., Kansas City, Mo.
Norton Co., 1 New Bond St., Worcester, Mass. (Diffuser Plate) "Alundum"
Refinite Corp., The, Omaha, Nebr.
Spray Engrg. Co., Somerville, Mass. (Nozzles)
Vogt Mfg. Co., Inc., 1404 W. Main St., Louisville, Ky. "Aer-o-mix"
Yeomans Brothers Co., 1433 Dayton St., Chicago, Ill.

Agitator, Filter Bed

Activated Alum Corp., 5701 Pennington Ave., Baltimore, Md.

Alarms—See Detection, Intrusion

Ammeters & Volt Meters, See Instruments, Indicating and Recording, Switchboard

Ammoniators

Amm-O-Feeder—See Proportioneers, Inc.
Everson Mfg. Co., 214 W. Huron St., Chicago, Ill.
Omega Machine Co., 4010 Penn Ave., Kansas City, Mo.
Proportioneers, Inc., 9 Codding St., Providence R. I., "Amm-O-Feeder"
Wallace & Tiernan Co., 11 Mill St., Newark, N. J.
Wilson Chemical Feeders, Inc., 110 Washington St., Buffalo, N. Y.

Arrester, Water Hammer

Wacor—See Water Hammer Arrester Co.
Water Hammer Arrester Co., 161 W. Wisconsin Ave., Milwaukee, Wis. "Wacor"

Batteries

Electric Storage Battery Co., Allegheny Ave. & 19th St., Philadelphia, Pa. "Exide"
Exide—See Electric Storage Battery Co.
Gould Storage Battery Corp., 35 Neoga St., Depew, N. Y.
Philco Corp., Battery Div., Ontario & C, Philadelphia, Pa.
Prest-O-Lite Battery Co., 4500 W. 16th St., Indianapolis, Ind.
Willard Storage Battery Co., 246 E. 131 St., Cleveland, Ohio. (Also for Diesel Starting)

WHO MAKES IT?

- This Roster of Waterworks Products and Services will answer many but by no means all of the questions on buying sources that beset the busy men who read these pages.
- For tracing to their source those elusive products that can't be found in directories, *Engineering News-Record* has extensive resources and facilities. These are gladly made available to readers who want help in answering "who makes it?"
- Address your inquiries to—Product Information Service, Engineering News-Record, 330 W. 42nd St., New York, N. Y.

Bentonite

American Colloid Co., 363 W. Superior St., Chicago, Ill. "Volclay"
Volclay—See American Colloid Co.

Blackout Material & Equipment

American Marietta Co., 43 E. Ohio St., Chicago, Ill. (Paint)
Carbozite Corp., Pittsburgh, Pa. (Paint)
Ilg Electric Ventilating Co., 2850 N. Pulaski St., Chicago, Ill. (Ventilators)
Photoswitch Inc., 21 Chestnut St., Cambridge, Mass. (Control)
Skybryte Co., The, 3125 Perkins St., Cleveland, Ohio (Paint)
Thompson & Co., P. O. Box 6757, Pittsburgh, Pa. (Paint)
Trane Co., The, LaCrosse, Wis. (Ventilators)
Wabash Appliance Corp., The, 335 Carroll St., Brooklyn, N. Y. (Electric Light Bulbs)
Wailes Dove-Hermiston Corp., Westfield, N. J. (Treatment) (Glass Anti-splinter Coating)

Blowers & Fans

Allen Billmyre Corp., 220 E. 42nd St., New York, N. Y.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Blower Corp., 6000 Russell St., Detroit, Mich. "Ventura"
Buffalo Forge Co., 481 Broadway, Buffalo, N. Y.
Clean-Air—See Nash Engrg Co.
Coppus Engrg. Corp., 344 Park Ave., Worcester, Mass.
De Laval Steam Turbine Co., Trenton, N. J.
Gardner-Denver Co., 100 Williamson St., Quincy, Ill.
Hytor—See Nash Engrg. Co.
Ingersoll-Rand Co., 11 Broadway, New York, N. Y. (Motorblower)
King Ventilating Co., Owatonna, Minn.
Lakeside Engrg. Corp., 222 W. Adams St., Chicago, Ill.
Multivane—See Sturtevant Co.
Nash Engineering Co., 218 Wilson Rd., South Norwalk, Conn. "Hytor" "Clean-Air"
Pennsylvania Pump & Compressor Co., Easton, Pa.
Rexvane—See Sturtevant Co.
Roots-Connersville Blower Corp., Connersville, Ind.

190,000 Tons of Aggregates Pumped in 1941 by 8-inch Amsco pump with Minimum Repairs

The Dallenbach Sand & Gravel Company, Milltown, New Jersey, producers of commercial concrete aggregates, enthusiastically commend the satisfactory performance of their Amsco Dredge Pump equipment. 190,000 tons of deposit materials were excavated during the 1941 season, of which 150,000 tons of sand and 15,000 tons of gravel were saleable and the balance wasted. An 8" Amsco, Type "M", Form 30, heavy duty dredge pump, directly connected to a 100 H.P., General Electric, 580 R.P.M., slip ring motor, is used for production. The average discharge pipe line is 500 feet, together with 30-foot terminal lift at the shore plant emptying position. Two years' results establish about 100 tons an hour average production, a commendable performance in that only a plain suction line is used and some areas of the deposit are tightly compacted.

Should future field conditions warrant longer discharge pipe line lengths coupled with higher head pump characteristics, the equipment is designed for ready adaptation of an Amsco "COUNTERFLOW" water end in conjunction with using a larger motor of 150 H.P. size at 705 R.P.M.

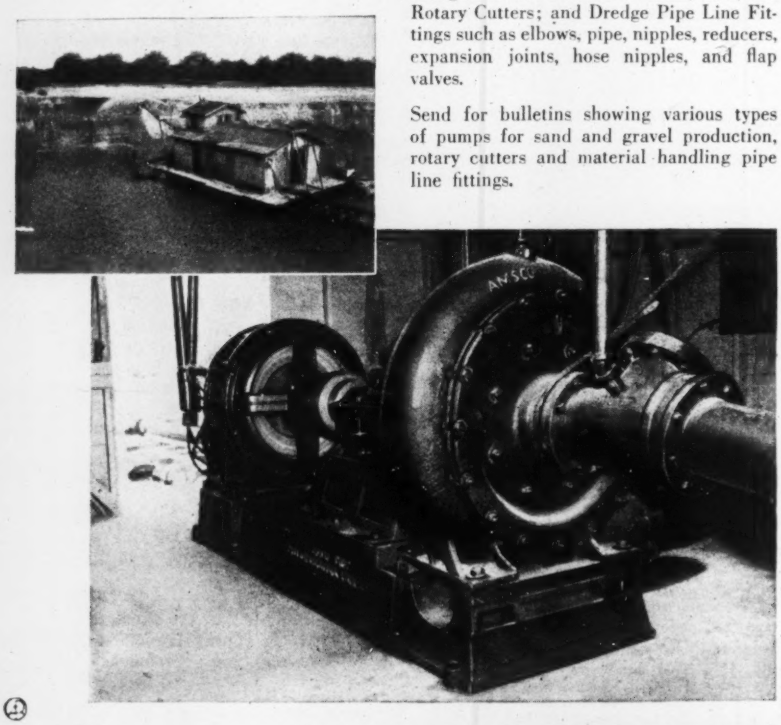
Continuous use of this equipment has demonstrated a minimum cost of maintenance parts and labor, together with optimum productive operating hours. Similarly, Amsco Dredge Pumps in hundreds of installations, over many years, have given satisfactory service, under every kind of working condition, at lowest cost per ton of material handled. Amsco Pumps evidence their ability to stand up when being pressed the hardest for production. It is thus that they have proved their superiority as users of Amsco Pumps will tell you.

Made of genuine 13% manganese steel throughout the water end, including the shell, impeller, side plates and liners, Amsco Dredge Pumps insure utmost resistance to impact and abrasion.

They embody sturdiness with rigidity of construction; heavily proportioned shafting and bearings; accessibility and quick, positive impeller adjustment; easy replacement of wearing parts; simple lubrication; highest maintained efficiency; and remarkably high capacity handled against high heads.

The toughness and wear hardness of Amsco Manganese Steel make it ideal, also, for Rotary Cutters; and Dredge Pipe Line Fittings such as elbows, pipe, nipples, reducers, expansion joints, hose nipples, and flap valves.

Send for bulletins showing various types of pumps for sand and gravel production, rotary cutters and material handling pipe line fittings.



Amsco

AMERICAN MANGANESE STEEL DIVISION
OF THE AMERICAN BRAKE SHOE & FOUNDRY CO.
Chicago Heights, Illinois

Manganese Steel Castings for shocks and abrasion.
Chromium-Nickel Alloy Castings for heat and corrosion resistance.
Power Shovel Dippers · Dredge and Industrial Pumps.
Welding Materials for reclamation and hard-surfacing.

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Blowers & Fans—(Continued)

Silentvane—See Sturtevant Co.
Sturtevant Co., B. F., 89 Broad St., Hyd Park, Boston, Mass. "Multivane" "Re vane" "Silentvane" "Turbovane"
Turbovane—See Sturtevant Co.
Ventura—See American Blower Corp.

Boxes, Meter, Valve, Service & Accessories

Bingham & Taylor Corp., 575 Howard St., Buffalo, N. Y.
Central Foundry Co., 386 Fourth Ave., New York, N. Y.
Clark Co., H. W., Mattoon, Ill.
Clow & Sons, James B., 201 N. Talman Ave., Chicago, Ill.
Copperhorn—See Ford Meter Box Co.
Coppersetter—See Ford Meter Box Co.
Ford Meter Box Co., Wabash, Ind. "Coppersetter" "Copperhorn"
Iowa Valve Co., Hubbell Bldg., Des Moines, Iowa.
M & H Valve & Fittings Co., Anniston, Ala.
Modern Iron Works, Quincy, Ill.
Mueller Co., Decatur, Ill.
National Cast Iron Pipe Co., Tarrant, Birmingham, Ala.
Northrop & Co., 50 Church St., New York, N. Y. (Distributors)
Rensselaer Valve Co., Troy, N. Y. (Valve)
Robinson Clay Products Co., 2nd National Bank Bldg., Akron, Ohio (Vitrified Clay)
Vogt Brothers Mfg. Co., 14th & Main Sts., Louisville, Ky.
Wood Co., R. D., 400 Chestnut St., Philadelphia, Pa.

Brick, Refractory or Fire

Green Fire Brick Co., A. P., Mexico, Mo.

Cable Electric, See Wire & Cable

Caulking, See Joints, Pipe

Cells, Photo Electric

Allen-Bradley Co., 1326 S. 2nd St., Milwaukee, Wis.
Amperite Corp., 561 Broadway, New York, N. Y.
Cetron—See Continental Electric Co.
Continental Electric Co., Hamilton St., Geneva, Ill. "Cetron"
DeVry Corp., 1111 W. Armitage Ave., Chicago, Ill.
Eby, Inc., Hugh H., 4700 Stenton Ave., Philadelphia, Pa.
General Electric Co., 1 River Road, Schenectady, N. Y.
Graybar Electric Co., Lexington Ave. at 43rd St., New York, N. Y. (Distributors)
Photoswitch Inc., 21 Chestnut St., Cambridge, Mass.
R.C.A. Mfg. Co., Radio Tron Div., Harrison, N. J.
Vacutron Corp., Arlington, W. Va.
Western Electric Co., 195 Broadway, New York, N. Y.
Westinghouse Lamp Div., Westinghouse Electric Co., Bloomfield, N. J.
Weston Electrical Instrument Co., 618 Frelinghuysen Ave., Newark, N. J.

Chqin, Power Transmission

Chain Belt Co., 1600 W. Bruce St., Milwaukee, Wis. "Rex"
Diamond Chain & Mfg. Co., 502 Kentucky Ave., Indianapolis, Ind.
Ewart—See Link-Belt Co.
Jeffrey Mfg. Co., 925 N. 4th St., Columbus, Ohio
Link-Belt Co., 220 S. Belmont Ave., Indianapolis, Ind. "Ewart" "Silverlink" "Silverstreak"

(Illustration from photo by U. S. Army Signal Corps.)

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● *Twenty years ago,* as little lads, these fighting men of today were pedaling tricycles down quiet streets, with no knowledge of a war just ended; no idea of a still greater war to come—a war in which they were to play so important a part.

Twenty years ago, in a world at peace, The Sisalkraft Co. began producing a tough reenforced waterproof paper, named SISALKRAFT, with no comprehension as to the important part it, too, would play in this world war.

For twenty years, The Sisalkraft Co. has been acclaimed the leader in the development and production of reenforced papers—papers that are recognized in all parts of the world *because of their outstanding performance in automatic curing of concrete, their waterproof protective quality, and their almost unbelievable strength.*

As a result of these twenty years of constant development and improvement, and due to exclusive construction methods and the designing of special equipment and machines, the SISALKRAFT of today requires a very minimum of sisal fibres.

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At the same time SISALKRAFT is releasing burlap, tarpaulin and other fabrics and protective materials for other important war uses.

Today the entire production of SISALKRAFT is being used for only those essential applications that will hurry the day of Victory.

It is curing the concrete floors in giant arms plants and factories from coast to coast. It is curing runways on vast new flying fields and hundreds of miles of strategic highways and access roads. It is protecting valuable materials and irreplaceable machinery and vital supplies.

The SISALKRAFT method of concrete curing has wide endorsement and acceptance among architects, contractors and engineers. It is smooth, efficient, automatic—*and does the job with less manpower and material,* and at low cost.

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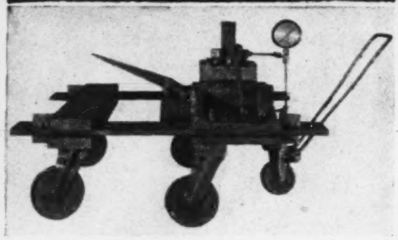

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Ramsey Chain Co., 1033 Broadway, Albany, N. Y.
Rex—See Chain Belt Co.
SA—See Stephens-Adamson Mfg. Co.
Silverlink—See Link-Belt Co.
Silverstreak—See Link-Belt Co.
Stephens-Adamson Mfg. Co., 570 Ridgeway Ave., Aurora, Ill. "SA"
Union Chain & Mfg. Co., Sandusky, Ohio
Whitney Chain & Mfg. Co., 237 Hamilton St., Hartford, Conn.

Chemicals

ACTIVATED CARBON

Activated Alum Corp., 5701 Pennington Ave., Baltimore, Md.
American Norit Co., Norwood, Jacksonville, Fla. (Factory) 551 Fifth Ave., New York (Sales) "Norit"
Aqua Nuchar—See Industrial Chemical Sales Div., West Virginia Pulp & Paper Co.
Cliffchar—See Cliffs Dow Chemical Co.
Cliffs Dow Chemical Co., Marquette, Mich. "Cliffchar"
Darco Corp., 60 E. 42nd, New York, N. Y. "Hydrodarco"
du Pont de Nemours & Co., Inc., E. I., Grasselli Chem. Dept., du Pont Bldg., Wilmington, Del.
General Carbon & Chemical Corp., Monroe, La. "Magnechar"
Hydrodarco—See Darco Corp.
Industrial Chemical Sales Div., West Virginia Pulp & Paper Co., 230 Park Ave., New York, N. Y. "Aqua Nuchar"
Infilco, Inc., 325 W. 25th Pl., Chicago, Ill.
Lakeside Engrg. Corp., 222 W. Adams St., Chicago, Ill.
Magnechar—See General Carbon & Chemical Corp.
Norit—See American Norit Co. and Salomon & Bro., L. A.
Salomon & Bro., L. A., 216 Pearl St., New York, N. Y. "Norit"
Stuart-Brumley Corp., 516 N. Charles St., Baltimore, Md.

ALUM

Activated Alum Corp., 5701 Pennington Ave., Baltimore, Md.
American Cyanamid & Chemical Corp., 30 Rockefeller Plaza, New York, N. Y.
du Pont de Nemours & Co., Inc., E. I. Grasselli Chem. Dept., du Pont Bldg., Wilmington, Del.
Faesy & Besthoff, Inc., 22 E. 40th St., New York, N. Y. (Distributors)
General Chemical Co, 40 Rector St., New York, N. Y.
Monsanto Chemical Co., 1700 S. Second St., St. Louis, Mo., also Merrimac Div., Everett, Mass.
Pennsylvania Salt Mfg. Co., Widener Bldg., Philadelphia, Pa.
Stuart-Brumley Corp., 516 N. Charles St., Baltimore, Md.

AMMONIA

American Cyanamid & Chemical Corp., 30 Rockefeller Plaza, New York, N. Y.
Barrett Co., 40 Rector St., New York, N. Y.
Dow Chemical Co., Great Western Div., 310 Sansome St., San Francisco, Calif.
du Pont de Nemours & Co., Inc., E. I. National Ammonia Div. du Pont Bldg., Wilmington, Del.
Electro Bleaching Gas Co., Niagara Alkali Co., 60 E. 42nd St., New York, N. Y.
General Chemical Co., 40 Rector St., New York, N. Y.
Michigan Alkali Co., 60 E. 42nd St., New York, N. Y., and Ford Bldg., Detroit, Mich.
Monsanto Chemical Co., 1700 S. Second St., St. Louis, Mo., also Merrimac Div., Everett, Mass.
Pennsylvania Salt Mfg. Co., Widener Bldg., Philadelphia, Pa.

BENOCLOR

Cloroben Corp., 90 Forrest St., Jersey City, N. J.

BLEACHING POWDER

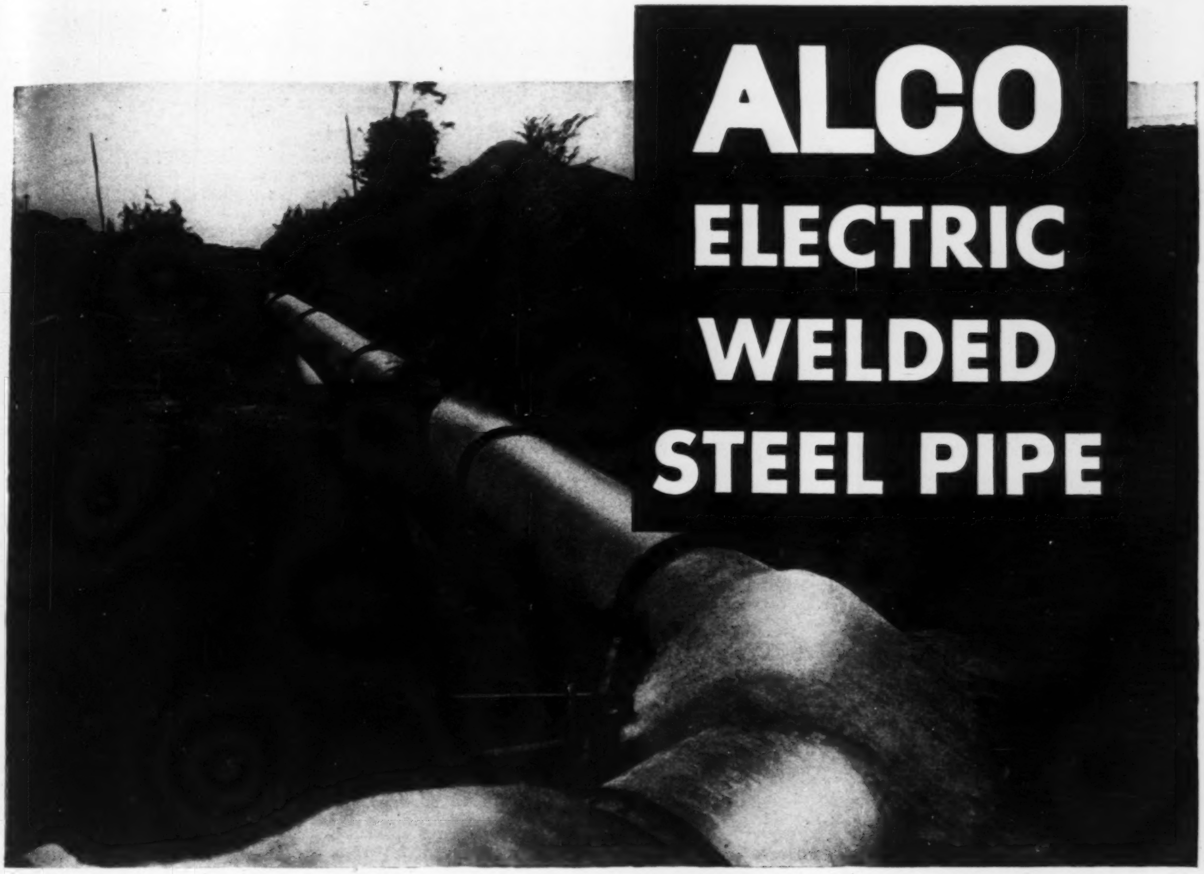
American Cyanamid & Chemical Corp. Calco Div., 30 Rockefeller Plaza, New York, N. Y.
du Pont de Nemours & Co., Inc., E. I., Grasselli Chem. Dept., du Pont Bldg., Wilmington, Del.
Electro Bleaching Gas Co., 60 E. 42nd St., New York, N. Y.
Faesy & Besthoff, Inc., 22 E. 40th St., New York, N. Y. (Distributors)
Handy-Pack—See Proportioneers, Inc.
Innis-Speiden & Co., 117 Liberty St., New York, N. Y.
Mathieson Alkali Works, 60 E. 42nd St., New York, N. Y.
Pennsylvania Salt Mfg. Co., Widener Bldg., Philadelphia, Pa.
Proportioneers, Inc., 9 Codding St., Providence, R. I. "Handy-Pack"

CAUSTIC SODA

American Cyanamid & Chemical Corp. Calco Div., 30 Rockefeller Plaza, New York, N. Y.
Columbia—See Pittsburgh Plate Glass Co.
Diamond Alkali Co., Pittsburgh, Pa.
Dow Chemical Co., Midland, Mich.
Electro Bleaching Gas Co., 60 E. 42nd St., New York, N. Y.
Faesy & Besthoff, Inc., 22 E. 40th St., New York, N. Y. (Distributors)
General Chemical Co., 40 Rector St., New York, N. Y.
Innis-Speiden & Co., 117 Liberty St., New York, N. Y.
Mathieson Alkali Works, 60 E. 42nd St., New York, N. Y.
Pennsylvania Salt Mfg. Co., Widener Bldg., Philadelphia, Pa.
Pittsburgh Plate Glass Co., Chemical Div., 30 Rockefeller Plaza, New York, N. Y. "Columbia"
Solvay Sales Corp., 40 Rector St., New York, N. Y.

CHLORINE

American Cyanamid & Chemical Corp., 30 Rockefeller Plaza, New York, N. Y.
Brown Co., 500 Fifth Ave., New York, N. Y.
Columbia—See Pittsburgh Plate Glass Co.
Diamond Alkali Co., Pittsburgh, Pa.
Dow Chemical Co., Great Western Div., 310 Sansome St., San Francisco, Calif.
du Pont de Nemours & Co., Inc., E. I., R & H Chemicals Dept., du Pont Bldg., Wilmington, Del.
Electro Bleaching Gas Co., Niagara Alkali Co., 60 E. 42nd St., New York, N. Y.
Hooker Electrochemical Co., Niagara Falls, N. Y.
Mathieson Alkali Works, Inc., 60 E. 42nd St., New York, N. Y.
Michigan Alkali Co., 60 E. 42nd St., New York, N. Y., and Ford Bldg., Detroit, Mich.
Monsanto Chemical Co., 1700 S. Second St., St. Louis, Mo., also Merrimac Div., Everett, Mass.
Pennsylvania Salt Mfg. Co., Widener Bldg., Philadelphia, Pa.
Pittsburgh Plate Glass Co., Columbia Chemical Div., 30 Rockefeller Plaza, New York, N. Y.
Solvay Sales Corp., 40 Rector St., New York, N. Y.



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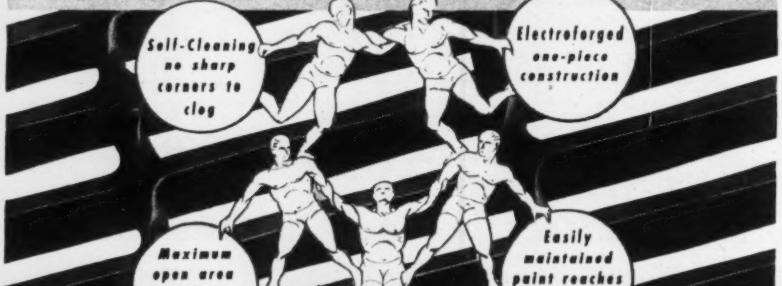
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Chemicals, (Continued)

COPPER SULPHATE

American Cyanamid & Chemical Corp., Calco Div., 30 Rockefeller Plaza, New York, N. Y.
du Pont de Nemours & Co., Inc., E. I., Grasselli Chem. Dept., du Pont Bldg., Wilmington, Del.
Faesy & Besthoff, Inc., 22 E. 40th St., New York, N. Y. (Distributors)
General Chemical Co., 40 Rector St., New York, N. Y.
Nichols Copper Co., 40 Wall St., New York, N. Y.
Phelps Dodge Refining Corp.—See Nichols Copper Co.
Tennessee Corp., 621 Grant Bldg., Atlanta, Ga.

FERRIC CHLORIDE

American Cyanamid & Chemical Corp. Calco Div., 30 Rockefeller Plaza, New York, N. Y.
Diamond Alkali Co., Pittsburgh, Pa.
Dow Chemical Co., Midland, Mich., also Great Western Div., 310 Sansome St., San Francisco, Calif.
du Pont de Nemours & Co., Inc., E. I., du Pont Bldg., Wilmington, Del. (Distributors)
General Chemical Co., 40 Rector St., New York, N. Y.
Hills-McCanna Co., 2349 Nelson St., Chicago, Ill.
Hooker Electrochemical Co., Niagara Falls, N. Y.
Innis, Speiden & Co., 117 Liberty St., New York, N. Y. "Isco"
Pennsylvania Salt Mfg. Co., Widener Bldg., Philadelphia, Pa.

FERRIC SULFATE

Activated Alum Corp., 5701 Pennington Ave., Baltimore, Md.
American Cyanamid & Chemical Corp. Calco Div., 30 Rockefeller Plaza, New York, N. Y.

FERROUS SULPHATE

du Pont de Nemours & Co., Inc., E. I., Grasselli Chem. Dept., du Pont Bldg., Wilmington, Del.
Faesy & Besthoff, Inc., 22 E. 40th St., New York, N. Y. (Distributors)
Ferri-Floc—See Tennessee Corp.
Ferrisul—See Monsanto Chemical Co.
General Chemical Co., 40 Rector St., New York, N. Y.
Monsanto Chemical Co., 1700 S. Second St., St. Louis, Mo., also Merrimac Div., Everett, Mass. "Ferrisul"
Tennessee Corp., 621 Grant Bldg., Atlanta, Ga. "Ferri-Floc"

HYDROCHLORIC ACID

Monsanto Chemical Co., 1700 S. Second St., St. Louis, Mo., also Merrimac Div., Everett, Mass.
Ozark Chemical Co., Cosden Bldg., Tulsa, Okla.
Pennsylvania Salt Mfg. Co., Widener Bldg., Philadelphia, Pa.

LIME

Innis-Speiden & Co., 117 Liberty St., New York, N. Y.
National Lime Assn., 927 16th St., N. W., Washington, D. C.
Oolitic—See Ste. Genevieve Lime Co.
Peerless—See Ste. Genevieve Lime Co.
Seal—See Ste. Genevieve Lime Co.
Ste. Genevieve Lime Co., 1424-1425 Ambassador Bldg., St. Louis, Mo., "OOlitic" "Peerless" "Seal" and Mosher, Mo.

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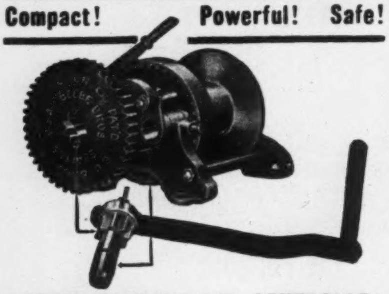

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Chemicals—(Continued)

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American Cyanamid & Chemical Corp., 30 Rockefeller Plaza, New York, N. Y.
Columbia—See Pittsburgh Plate Glass
Diamond Alkali Co., Pittsburgh, Pa.
du Pont de Nemours & Co., Inc. E. I. Grasselli Chemical Dept. du Pont Bldg., Wilmington, Del. (Distributors)
Electro Bleaching Gas Co., Niagara Alkali Co., 60 E. 42nd St., New York, N. Y. (Distributors)
General Chemical Co., 40 Rector St., New York, N. Y.
Innis-Speiden & Co., 117 Liberty St., New York, N. Y. "Isco"
Isco—See Innis-Speiden & Co.
Mathieson Alkali Works, Inc., 60 E. 42nd St., New York, N. Y.
Michigan Alkali Co., 60 E. 42nd St., New York, N. Y., and Ford Bldg., Detroit, Mich.
Monsanto Chemical Co., 1700 S. Second St., St. Louis, Mo., also Merrimac Div., Everett, Mass.
Pennsylvania Salt Mfg. Co., Widener Bldg., Philadelphia, Pa.
Pittsburgh Plate Glass Co., Columbia Chemical Div., 30 Rockefeller Plaza, New York, N. Y.
Solvay Sales Corp., 40 Rector St., New York, N. Y.

SODIUM ALUMINATE

American Cyanamid & Chemical Corp. Calco Div., 30 Rockefeller Plaza, New York, N. Y.
General Chemical Co., 40 Rector St., New York, N. Y.
Monsanto Chemical Co., 1700 S. Second St., St. Louis, Mo., also Merrimac Div., Everett, Mass.
Pennsylvania Salt Mfg. Co., Widener Bldg., Philadelphia, Pa.

SODIUM CHLORIDE

General Chemical Co., 40 Rector Street, New York, N. Y.
Mathieson Alkali Works, Inc., 60 E. 42nd St., New York, N. Y.

SODIUM OR CALCIUM HYPOCHLORITE

General Chemical Co., 40 Rector St., New York, N. Y.
Mathieson Alkali Works, Inc., 60 E. 42nd St., New York, N. Y.
Merclor—Monsanto Chemical Co.
Monsanto Chemical Co., 1700 S. Second St., St. Louis, Mo., also Merrimac Div., Everett, Mass. "Merclor"
Pennsylvania Salt Mfg. Co., Widener Bldg., Philadelphia, Pa. "Perchloron" (Calcium Hypochlorite)
Perchloron—See Pennsylvania Salt Mfg. Co.

SULPHUR DIOXIDE

American Cyanamid & Chemical Corp., Calco Div., 30 Rockefeller Plaza, New York, N. Y.
Ansul Chemical Co., Marinette, Wis.
Esotoo—See Virginia Smelting Co.
Virginia Smelting Co., West Norfolk, Va. "Esotoo" (Liquid)

SULPHURIC ACID

du Pont de Nemours & Co., Inc., E. I., Grasselli Chem. Dept., du Pont Bldg., Wilmington, Del.
Monsanto Chemical Co., 1700 S. Second St., St. Louis, Mo., also Merrimac Div., Everett, Mass.
Ozark Chemical Co., Cosden Bldg., Tulsa, Okla.
Pennsylvania Salt Mfg. Co., Widener Bldg., Philadelphia, Pa.

Chlorinators

American Water Softener Co., Inc., 4th & Lehigh Ave., Philadelphia, Pa.
Chlor-O-Feeder—See Proportioneers, Inc.
Dr. Robt. L. Furby's Liquid Proportioner Co., 1015 Bedell Bldg., Portland, Ore.
Everson Mfg. Co., 214 W. Huron St., Chicago, Ill. "Sterelators"
Municipal Service Co., 532 Dwight Bldg., Kansas City, Mo.
Omega Machine Co., 4010 Penn. Ave., Kansas City, Mo.
Phipps & Bird, Inc., 915 E. Cary St., Richmond, Va.
Proportioneers, Inc., 9 Codding St., Providence, R. I. "Chlor-O-Feeder" (Also Hypo-Chlorinators)
Roy Pumps, Milton, 1361 E. Mermaid Ave., Philadelphia, Pa.
Sterelators—See Everson Mfg. Co.
Taylor & Co., W. A., 7300 York Rd., Baltimore. Md.
Wallace & Tiernan Co., 11 Mill St., Newark, N. J.
Wilson Chemical Feeders, Inc., 110 Washington St., Buffalo, N. Y. (Also Hypo-Chlorinators)

Clamps, Pipe—see also Joints, Pipe

American Cast Iron Pipe Co., 2930 N. 16th St., Birmingham, Ala.
Carson-Cadillac Co., 1221 Pinson St., Birmingham, Ala. (Bell Joint)
Clow & Sons, Jas. B. 201 N. Talman Ave., Chicago, Ill.
Dresser Mfg. Co., Bradford, Pa.
Northrup & Co., 50 Church St., New York, N. Y. (Distributors)
Skinner Co., M. B., South Bend, Ind.

Clarifiers

Chain Belt Co., 1600 W. Bruce St., Milwaukee, Wis.
Dorr Co., 570 Lexington Ave., New York, N. Y.
Infilco, Inc., 325 W. 25th Pl., Chicago, Ill.
Jeffrey Mfg. Co., E. First Ave., Columbus, Ohio
Lakeside Engineering Corp., 222 W. Adams St., Chicago, Ill.
Link-Belt Co., 2045 W. Hunting Park Ave., Philadelphia, Pa.
Yeomans Brothers Co., 1433 Dayton St., Chicago, Ill.

Cleaners

Curran Corp., Malden, Mass. (Grease & Dirt Solvent)
L&R Mfg. Co., 54 Clinton St., Newark, N. J. (Precision Mechanisms)
Magnus Chemical Co., Inc., Garwood, N. J.
Oakite Products Co., 56 Thames St., New York, N. Y.
Petroleum Solvents Corp., 331 Madison Ave., New York, N. Y. (Engines & Fuel Tanks)

Cleaners, Flame for Metal Painting

Air Reduction Sales Co., 60 E. 42nd St., New York, N. Y.
Linde Air Products Co., The, Unit of Union Carbide and Carbon Corp., 30 E. 42nd St., New York, N. Y.

Cleaners, Pipe

Flexible Sewer Rod Equipment Co., 9059 Venice Blvd., Los Angeles, Calif.
General Pipe Cleaning Co., Commercial Trust Bldg., Philadelphia, Pa.
National Water Main Cleaning Co., 30 Church St., New York, N. Y.

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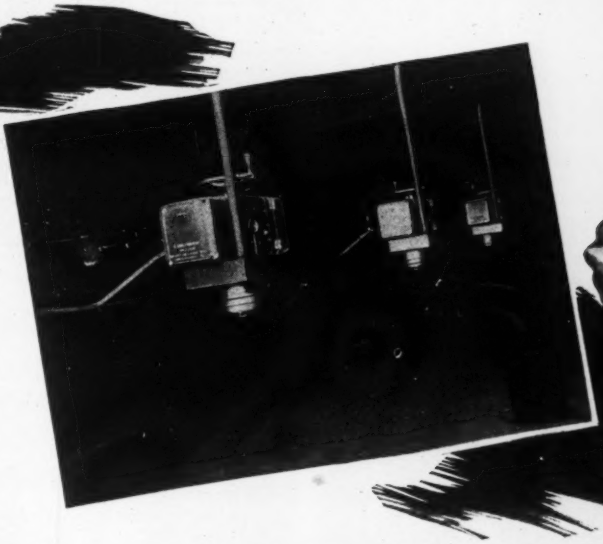

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The economical self-contained drive, Horizontal or Vertical types — various ratios and horsepowers.

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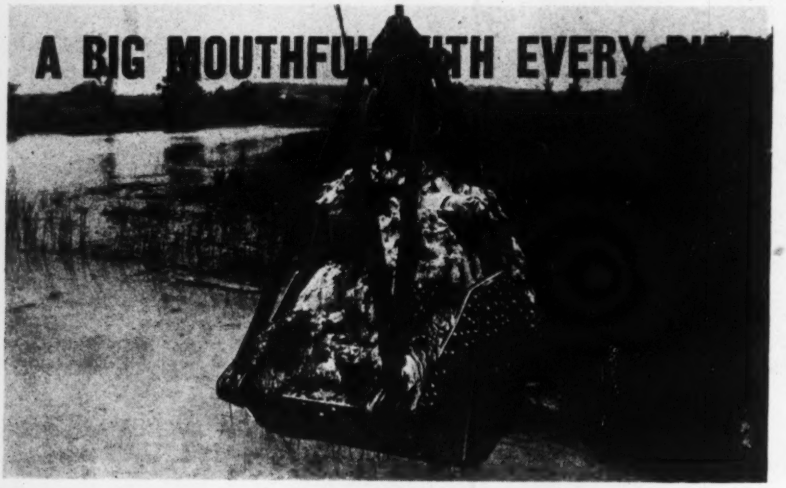

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Pittsburgh Pipe Cleaner Co., 1016 Suismon St., Pititsburgh, Pa.
Roto-Rooter Corp., 2302 University Ave., Des Moines, Iowa (Equipment)
Self Propelling Nozzle Co., 225 Lafayette St., New York, N. Y. (Equipment)

Coagulants, see Chemicals

Coagulators

Carter Co., Ralph B., 192 Atlantic St., Hackensack, N. J. "Flocers"
Chain Belt Co., 1600 W. Bruce St., Milwaukee, Wis.
Dorr Co., 570 Lexington Ave., New York, N. Y. "Flocculators"
Flocculators—See Dorr Co.
Flocers—See Carter Co., Ralph B.
Floctrol—See Jeffrey Mfg. Co.
Graver Tank & Mfg. Co., 4809 Todd Ave., East Chicago, Ind.
Infilco, Inc., 325 W. 25th Pl., Chicago, Ill.
Jeffrey Mfg. Co., E. First Ave., Columbus, Ohio "Floctrol"
Lakeside Engrg. Corp., 222 W. Adams St., Chicago, Ill.
Link-Belt Co., 2045 W. Hunting Park Ave., Philadelphia, Pa.
Municipal Service Co., 532 Dwight Bldg., Kansas City, Mo.
Vogt Mfg. Co., Inc., 1404 W. Main St., Louisville, Ky.
Wilson Chemical Feeders, Inc., 110 Washington St., Buffalo, N. Y.

Coatings, Pipe

Asphalt Products Co., Thompson Rd., Syracuse, N. Y.
Barrett Co., 40 Rector St., New York, N. Y.
Flintkote Co., The, 30 Rockefeller Plaza, New York, N. Y.
General Paint Corp., Hill, Hubbell & Co. Div., 3091 Mayfield Rd., Cleveland, Ohio
Inertol Co., 470 Frelinghuysen Ave., Newark, N. J.
J-M—See Johns-Manville Corp.
Johns-Manville Corp., 22 E. 40th St., New York, N. Y.
Koppers Co., Tar & Chemical Div., Koppers Bldg., Pittsburgh, Pa.
Plastex—See Steel Protection & Chemical Co.
Quigley Co., 56 W. 45th St., New York, N. Y.
Reilly Tar & Chemical Co., Merchants Bank Bldg., Indianapolis, Ind.
Steel Protection & Chemical Co., Mooresville, Ind. "Plastex"
Wailes Dove-Hermiston Corp., Westfield, N. J.
X-Pando Corp., 43-15 36th St., Long Island City, N. Y.

Coatings, Protective — see also Galvanizing, Paint, & Lining, Rubber

Chempruf—See Protective Coatings
Glasshield—See Maas & Waldstein Co.
Maas & Waldstein Co., 438 Riverside Ave., Newark, N. J. "Glasshield" (Transparent antishatter)
Rogear Co., 11 Water St., New York, N. Y. "Wet-X-Hale"
Wet-X-Hale—See Rogear Co.
Protective Coatings, Inc., 10401 Northlyn, Detroit, Mich. "Chempruf" (Lining)

Cocks, Curb, Meter, Corporation, Etc.

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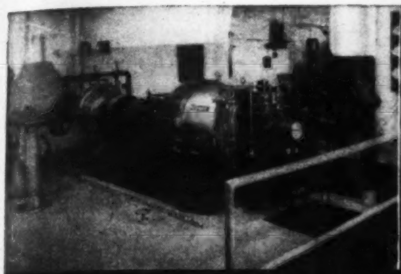
Farnan Brass Works Co., 1104 Center Ave., Cleveland, Ohio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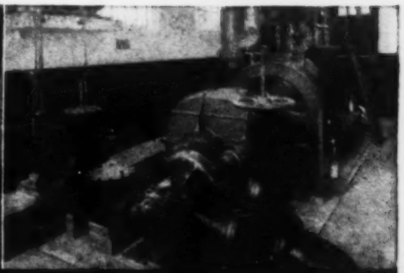
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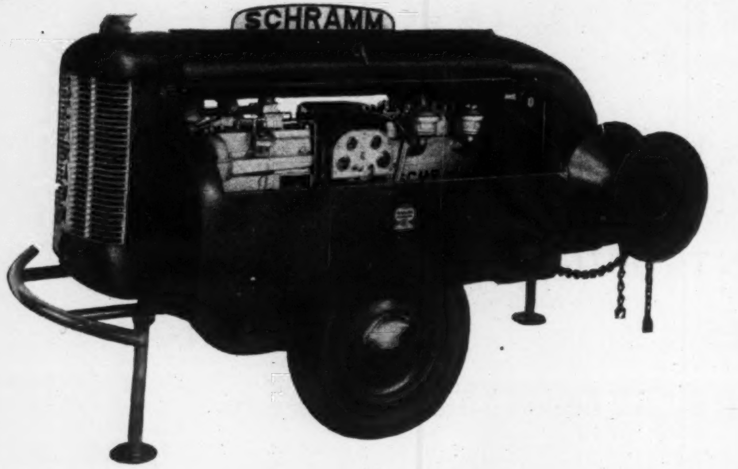

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Allis-Chalmers Mfg. Co., Milwaukee, Wis. "Ro-Twin"
Beach-Russ Co., 50 Church St., New York, N. Y.
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Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y. "CP"
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Fuller Co., Catasauqua, Pa.
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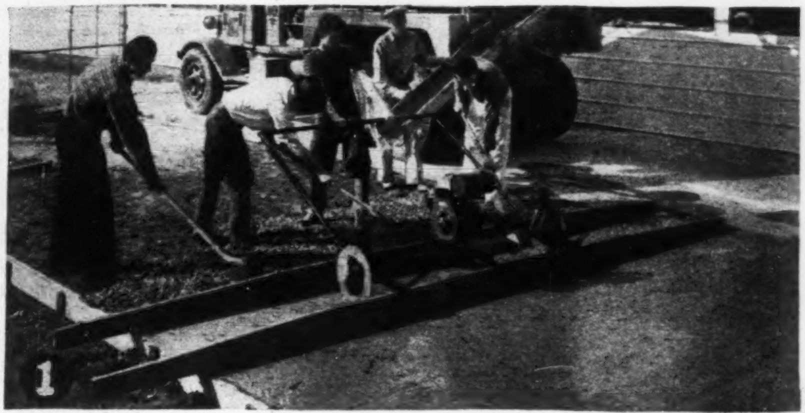

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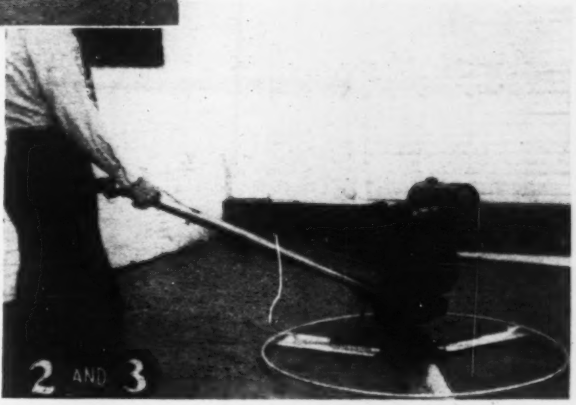

Even on rush work, concrete is quickly and thoroughly compacted for maximum density when laid with WHITEMAN Machines. Slow, labor-consuming hand work is eliminated when you adopt the WHITEMAN 3-Step method to get better concrete in two-thirds the time.

There is a WHITEMAN machine for each operation from screeding through floating and finishing. Each one multiplies the production capacity of your crews—each machine does a better job than can be done by hand.

Here's the WHITEMAN 3-Step method:

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3. FINISHING—Attach the 17 gage steel "Finish" trowels to the same dual purpose WHITEMAN Finishing Machine then the operator guides the rotating, adjustable-pitch trowels over the slab. Without handwork, a smooth, level surface is finished in half the usual time. Again, one man covers 1,000 sq. ft. in 13 minutes.

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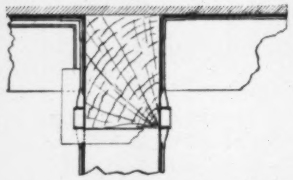
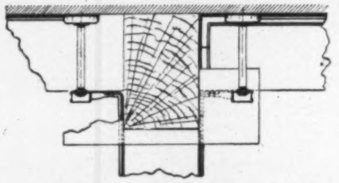
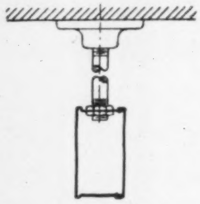
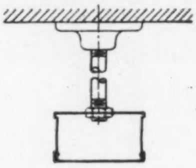
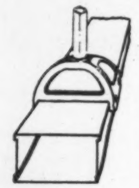
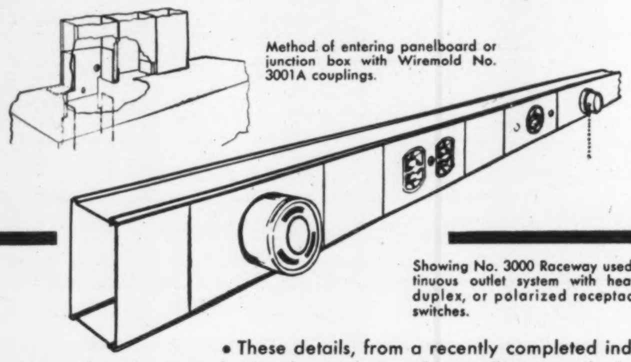

Wiremold No. 3000 mounted on sides of ceiling beams for grouped branch circuits, showing take-off to ceiling fixture boxes and switch and receptacle boxes on columns.


Method of feeding ceiling outlets from back of No. 3000 Raceway with ⅜" or ½" conduit and wall or switch outlets from side of raceway.


Raceway supported from side with ⅜" stem hanger.


Raceway supported from back with ⅜" stem hanger.


Raceway supported with Wiremold No. 3008C hanger.


Method of entering panelboard or junction box with Wiremold No. 3001A couplings.

Showing No. 3000 Raceway used as continuous outlet system with heavy duty, duplex, or polarized receptacles and switches.

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Nocrete—See Fibre Conduit Co.
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Square D Co., 6060 Rivard St., Detroit, Mich.
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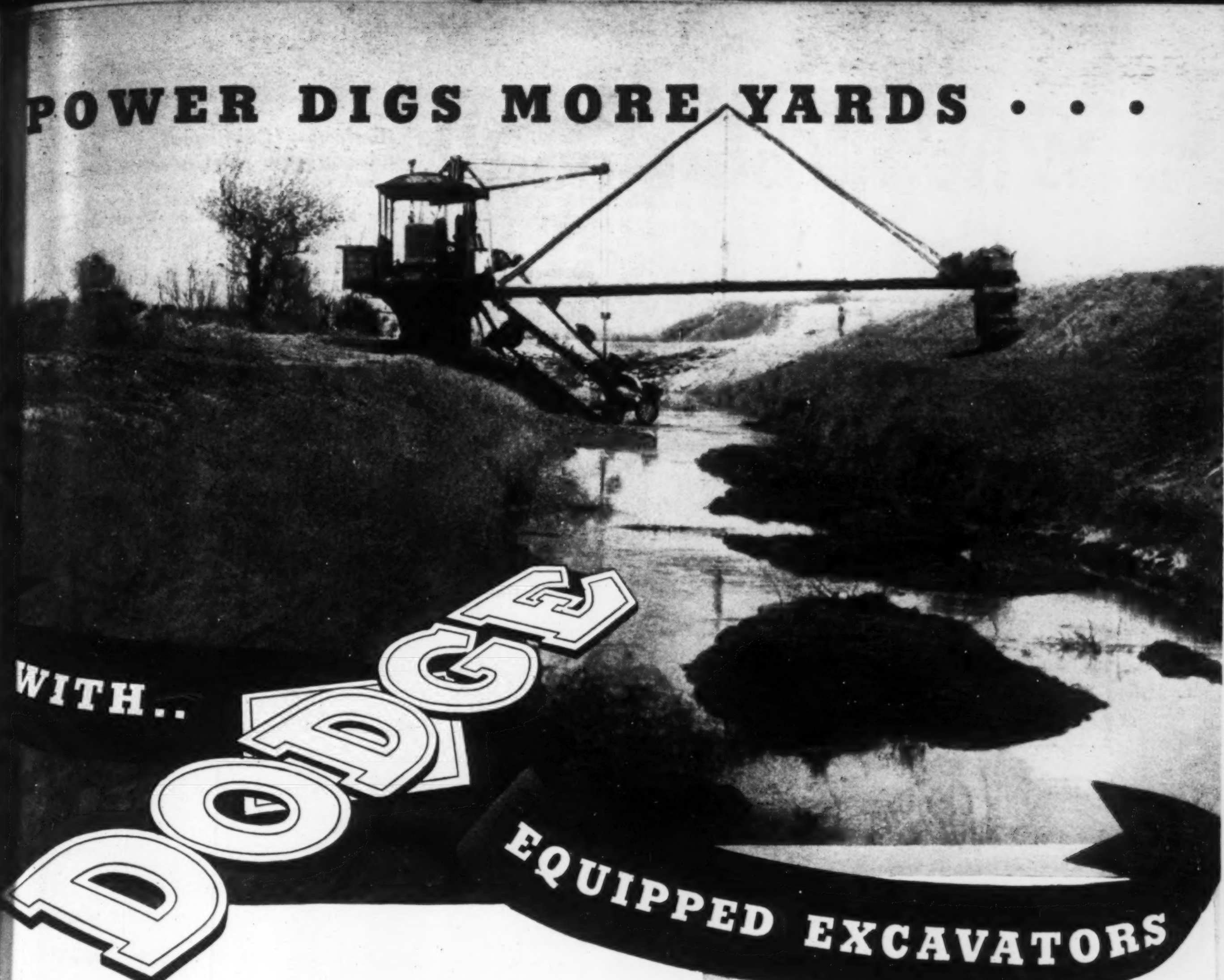

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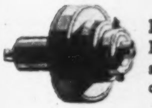

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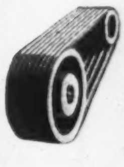

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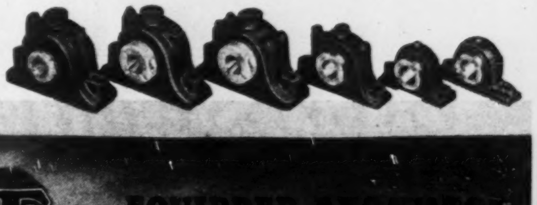

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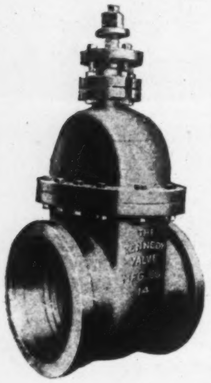

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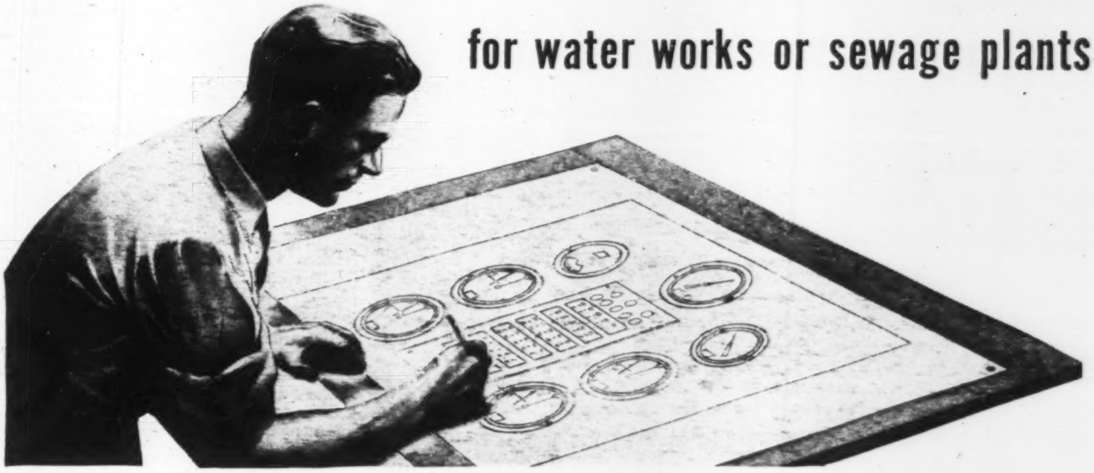

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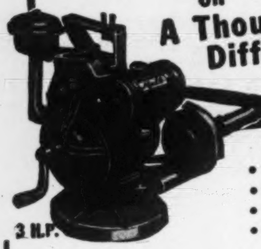

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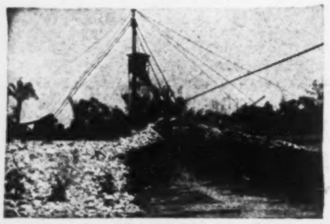

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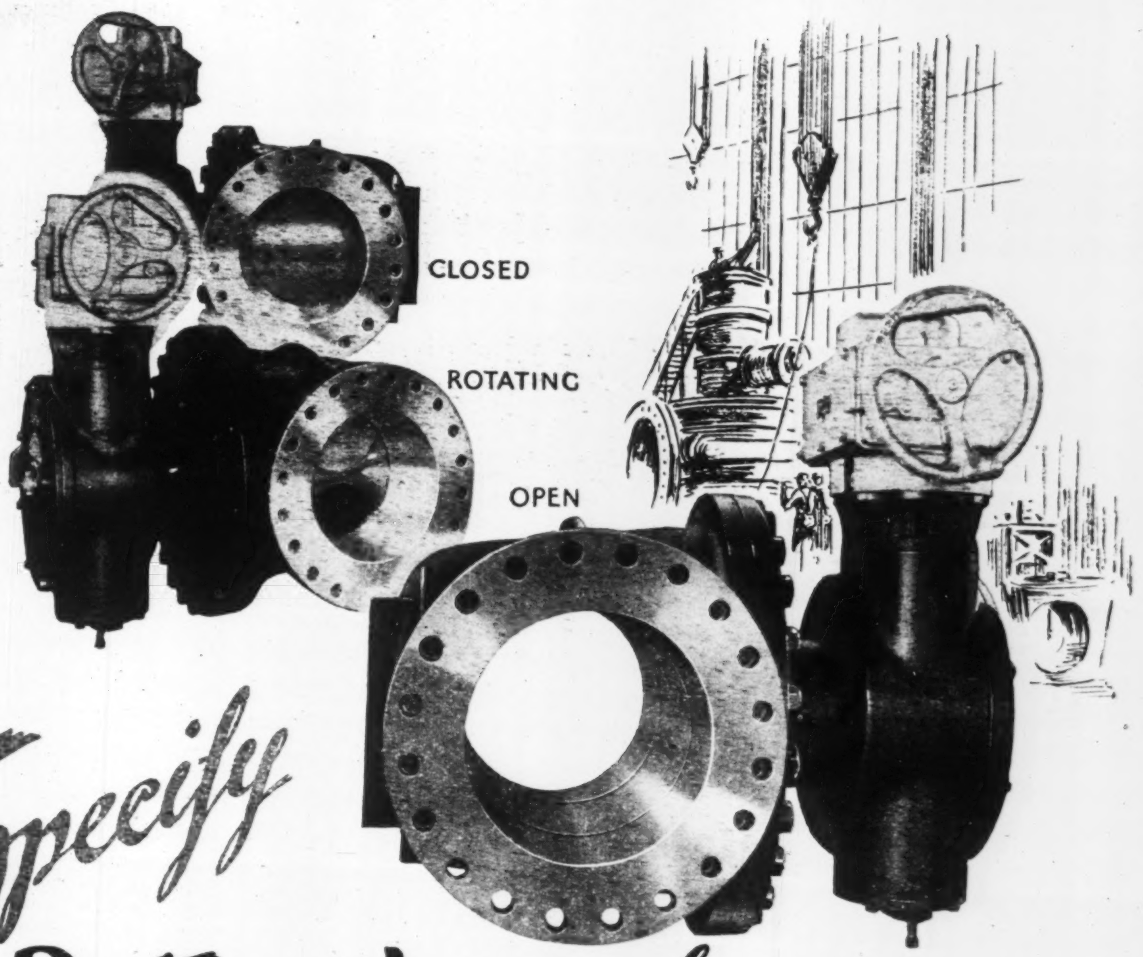
Darley, W. S. & Co., 2810 W. Washington Blvd., Chicago, Ill. "Sonoscopes"



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De LaVergne Sales Corp., Eddystone, Pa.
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Novo Engine Co., Lansing, Mich.
Waukesha Motor Co., Waukesha, Wis.
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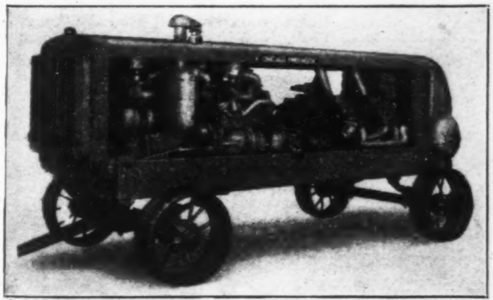

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De-Oxo-Lin—See Flameproofing Engineering Co.
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Indian—See Smith & Co., D. B.
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Staten Island Chemical Corp., The, 40 Exchange Pl., New York, N. Y. "Cen-d-out" (Incendiary Bombs)

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American Water Softener Co., Inc., 4th & Lehigh Ave., Philadelphia, Pa.
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Calgon-Feeder—See Proportioneers, Inc.
Carb-O-Feeders—See Proportioneers, Inc.
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Scaife & Sons Co., Wm. B., 26 Ann St., Oakmont, Pa.
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Soda-Feeders—See Proportioneers, Inc.
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Interlocking Fence Co., 940 Walnut St., Morton, Ill.
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Anthrafilt — See Anthracite Equipment Corp.
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ELECTRIC

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Ellipto-Lite—See Benjamin Electric Mfg. Co.
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National Carbide Corp., 60 E. 42nd St., New York, N. Y.
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Westinghouse Electric Supply Co., 150 Varick St., New York, N. Y. (Distributors) (Also anti-sabotage fence lights)

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Texas Co., The, 135 E. 42nd St., New York, N. Y.
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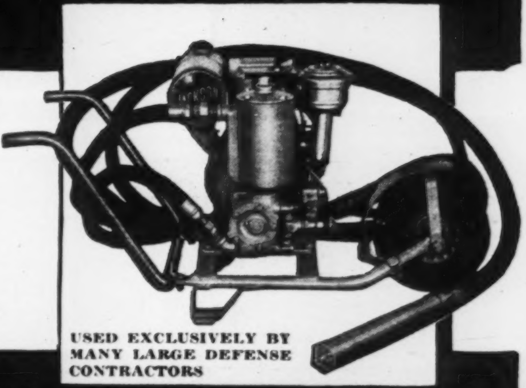

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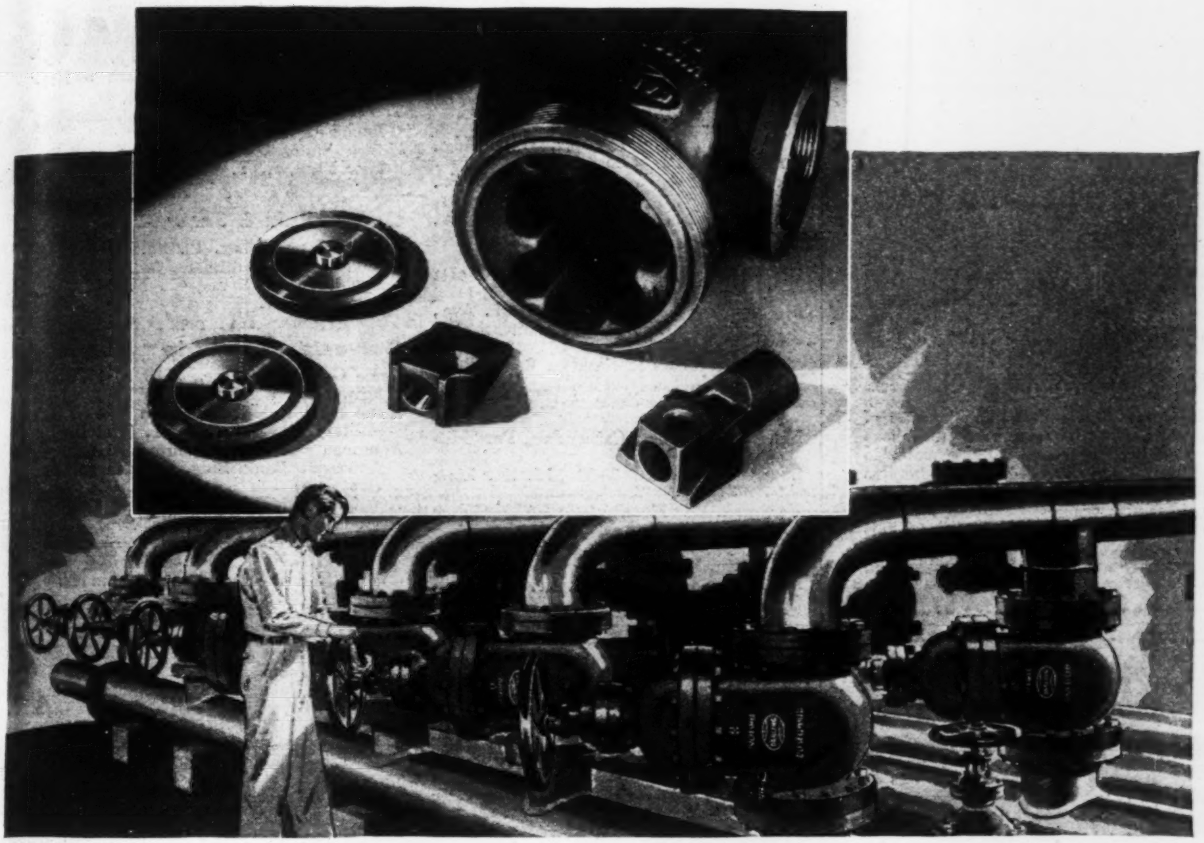


You write your own DARLING VALVE GUARANTEE

Here are the 4 reasons any Darling Valve will serve you better

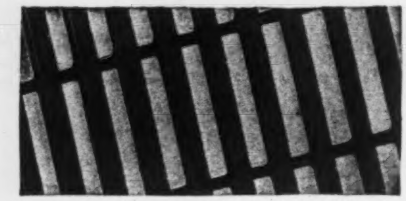
● Longer life, better service for you are *designed into* Darling Valves with these 4 simple parts that have stood up under industry's toughest jobs for more than 40 years. The parallel discs are *fully revolving*—they never seat in exactly the same position in any two closings. That means wear is uniform and is distributed evenly over the entire surface of the discs. There is no other valve with this design. Darling gives you what you buy, a valve for *positive seating* over longer service. Men in the service departments of a dozen industries prefer Darling Valves because they last longer, cost less to maintain, cost *least* per gallon delivered per year of use.

We'll put the right Darling Valve in your toughest control point, and *you* write the guarantee. Call in the Darling Valve & Manufacturing Co., Williamsport, Pa.

Darling offers you a quality line of longer-lasting Gate Valves. They come in Fully Revolving Parallel Seat Double Disc, also in Taper Seat—Slotted and Solid Wedge types. In service pressures up to 3000 pounds, you can get Darling Gate Valves in Cast Iron, Bronze, Forged Steel, Cast Steel, and Corrosion Resistant Alloys. Darling also manufactures Compression Type Fire Hydrants, Check Valves, Motor and Cylinder Operated Valves, and many accessories.

TRADE
DARLING
MARK
VALVE & MANUFACTURING CO.
WILLIAMSPORT, PA.

BATESGRATES
FILLET WELD



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Batesgrates are self-cleaning because of peaked, non-skid cross bar. They have no grooves or rough burned metal to catch grease or dirt. Safe traction Batesgrates are strictly one piece — no cuts, slots, or punching. Made from Hexagon Shaped Hot Rolled Steel Bars with smoother, larger, much stronger welds. Send today for engineering Catalog No. 937.

When you need grates
SPECIFY BATES
for long-time economy

WALTER BATES CO.
208 S. LaSalle St., Chicago, Ill.

"TO ECONOMIZE — GALVANIZE AT ENTERPRISE"

Over 40 years' experience in quality galvanizing to meet the most exacting specifications.

. . . And, our large, modern plant is planned and manned to handle large tonnages. Big job, or small, we're prepared to make *prompt delivery!*

Galvanized Products Furnished. Deliveries by boat, truck or any railroad.
"Regular Suppliers to the U. S. Government for over 40 years."

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Arrowhead Iron Works 431 W. 5th St., Kansas City, Mo.
Bates Co., Walter, 208 S. La Salle St., Chicago, Ill. "Batesgrates"
Batesgrates—See Bates Co., Walter
Beacon Steel Prods. Co., Inc., 12 E. 41st St., New York, N. Y.
Belmont Iron Works, 22nd & Wash. Ave., Philadelphia, Pa., also 44 Whitehall St., New York, N. Y.
Blaw-Knox Co., 601 Farmers Bank Bldg., Pittsburgh, Pa.
Dravo Corp., 300 Penn Ave., Pittsburgh, Pa. "Tri-Lok"
Hendrick Mfg. Co., Carbondale, Pa. "Mitco"
Irving Iron Works, 50-09 27th St., Long Island City, N. Y.
Kerlow Steel Flooring Co., 220 Culver Ave., Jersey City, N. J.
Klemp Co., Wm. F., 6611 S. Melvina Ave., Chicago, Ill.
Mitco—See Hendrick Mfg. Co.
Open Steel Flooring Institute, Inc., American Bank Bldg., Pittsburgh, Pa.
Reliance Steel Pdts. Co., 3700 Walnut St., McKeesport, Pa.
Seelauton Co., Inc., 2500 W. 27th St., Cleveland, Ohio
Standard Steel Spring Co., 2685 E. Fifth Ave., Gary, Ind.
Tri-Lok—See Dravo Corp.

STEEL

A.W.—See Alan Wood Steel Co.
Carnegie-Illinois Steel Corp., U. S. Steel Corp. Sub., Carnegie Bldg., Pittsburgh, Pa.
Inland Steel Co., 38 S. Dearborn St., Chicago, Ill.
Alan Wood Steel Co., Conshohocken, Pa. "A.W."

Forms, Concrete Pipe

Concrete Pipe Machinery Co., 9th & Division St., Sioux City, Iowa (Machinery)
Quinn Wire & Iron Works, 1625-12th St., Boone, Iowa.

Fuller's, Earth

Tammis Silica Co., 228 N. LaSalle St., Chicago, Ill.

Furnaces, Lead Melting

Hauck Mfg. Co., 124-136 Tenth St., Brooklyn, N. Y.
Littleford Bros., 453 Pearl St., Cincinnati, Ohio
Pollard Co., Joseph G., 142 Ashland Pl., Brooklyn, N. Y.

Gages, Pressure & Vacuum

Bailey Meter Co., 1050 Ivanhoe Rd., Cleveland, Ohio
Bristol Co., Waterbury, Conn.
Brown Instrument Co., 4536 Wayne Ave., Philadelphia, Pa.
Esterline-Angus, Co., Inc., P. O. Box 596, Indianapolis, Ind.
Foxboro Co., Foxboro, Mass.
Hays Corp., 905 Eighth Ave., Michigan City, Ind.
Lonergan Co., J. E., 217 Race St., Philadelphia, Pa.
Precision Thermometer & Instrument Co., 1434 Brandywine St., Philadelphia, Pa.
Republic Flow Meters Co., 2240 Diversey Pkwy., Chicago, Ill.
Stokes Machine Co., F. J., 5968 Tabor Rd., Olney P. O., Philadelphia, Pa.
Tagliabue Mfg. Co., C. J. Park & Nostrand Ave., Brooklyn, N. Y.
Taylor Instrument Cos., 100 Ames St., Rochester, N. Y.
United States Gauge Co., 44 Beaver St., New York, N. Y.

Gages, Rain & Snow

Friez & Sons, Julien, P., Baltimore St. & Central Ave., Baltimore, Md.
Leupold, Volpel, & Co., 425 N.E. 70 Ave., Portland, Ore.

Galvanizing, Hot Dip

Acme Galvanizing, Inc., 2730 S. 19th St., Milwaukee, Wis. (Hot Dip)
Acme Steel & Malleable Iron Works, 245 Military Rd., Buffalo, N. Y. (Hot Dip)
American Hot Dip Galvanizers Assn., Inc., American Bank Bldg., Pittsburgh, Pa. (Hot Dip)
American Tinning & Galvanizing Co., 552 W. 12th St., Erie, Pa. (Hot Dip)
Atlantic Stamping Co., 156 Ames St., Rochester, N. Y. (Hot Dip)
Atlantic Steel Co., 1365 Mecaslin N.W., Atlanta, Ga. (Hot Dip)
Buffalo Galvanizing & Tinning Works, 320 Terrace St., Buffalo, N. Y. (Hot Dip)
Diamond Expansion Bolt Co., 500 North Ave., Garwood, N. J. (Hot Dip)
Enterprise Galvanizing Co., 2500 E. Cumberland St., Philadelphia, Pa. (Hot Dip)
Equipment Steel Products Div., of Union Asbestos & Rubber Co., Blue Island, Ill. (Hot Dip)
Fanner Mfg. Co., Brookside Park, Cleveland, Ohio (Hot Dip)
Finn Metal Works, John, 384 Second St., San Francisco, Cal. (Hot Dip)
Galv-Weld, Inc., Mutual Home Bldg., Dayton, Ohio
Gregory Galvanizing Works, Thomas, Maspeth, N. Y. (Hot Dip)
Hanlon-Gregory Galvanizing Co., 5515 Butler St., Pittsburgh, Pa. (Hot Dip)
Hill Mfg. Co., James, 20 Gordon Ave., Providence, R. I. (Hot Dip)
Hubbard & Co., 1250 45th St., Oakland, Cal. (Hot Dip)
Independent Galvanizing Co., 39 Verona Ave., Newark, N. J. (Hot Dip)
International-Stacey Corp., 875 Michigan Ave., Columbus, Ohio (Hot Dip)
Isaacson Iron Works, 2917 E. Marg. Way, Seattle, Wash. (Hot Dip)
Joslyn Co. of California, 5100 District Bldg., Los Angeles, Cal. (Hot Dip)
Joslyn Mfg. & Supply Co., 20 N. Wacker Drive, Chicago, Ill. (Hot Dip)
Koven & Brother, Inc., L. O., 154 Ogden Ave., Jersey City, N. J. (Hot Dip)
Lehigh Structural Steel Co., Foot of Allen St., Allentown, Pa. (Hot Dip)
Lewis Bolt & Nut Co., 504 Malcolm Ave., Minneapolis, Minn. (Hot Dip)
Missouri Rolling Mill Corp., 6800 Manchester, St., St. Louis, Mo. (Hot Dip)
National Telephone Supply Co., 5100 Supr., Cleveland, Ohio (Hot Dip)
Penn Galvanizing Co., 2201 E. Tioga St., Philadelphia, Pa. (Hot Dip)
Riverside Foundry & Galvanizing Co., Kalamazoo, Mich. (Hot Dip)
San Francisco Galvanizing Works, 1176 Harrison, San Francisco, Cal. (Hot Dip)
Sanitary Tinning Co., 3753 E. 93rd St., Cleveland, Ohio (Hot Dip)
Standard Galvanizing Co., 2619 W. Vanburn St., Chicago, Ill. (Service) (Hot Dip)
Wilcox, Crittenden & Co., Middletown, Conn. (Hot Dip)
Witt Cornice Co., 2118 Winchell St., Cincinnati, Ohio (Hot Dip)

SAVE

up to 40 minutes per day per truck!

Defense construction of all kinds needed in a hurry! This Rex Hi-Discharge Moto-Mixer is one of countless Rex's filling this need on defense projects all over the western hemisphere.

A SAVING of 40 minutes per day per truck means a lot these days on any ready-mixed job. And that's what Rex Moto-Mixer users are getting these days, thanks to *quick-as-a-flash end-charging*. Rex has eliminated the time-wasting charging door of ordinary truck mixers and the need for having truck operators leave their cabs during charging operations. This alone saves as much as 5 minutes a batch!

This alone would be reason for standardizing on Rex on jobs where speed is at a premium—but there are others, too.

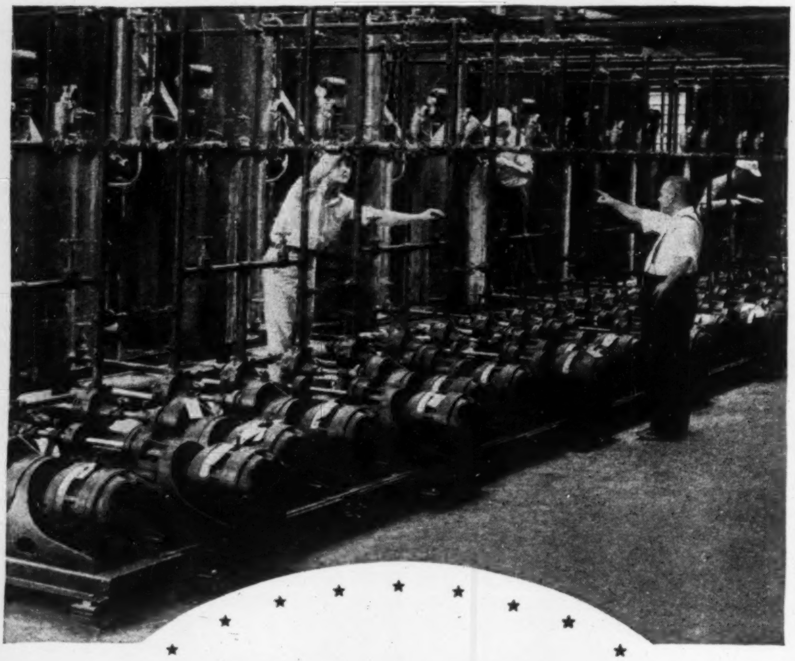
For instance, the Rex Hi-Lo mixing action means faster and more thorough mixing; and the handy Rex Quint-Spout makes discharging easier, under all conditions.

You'll get a new slant at what a truck mixer can offer you in the way of speed and economy on today's "high pressure" jobs, if you send for the Rex Hi-Discharge Moto-Mixer Catalog. Just address 1633 W. Bruce St., Milwaukee, Wisconsin.

REX MOTO-MIXERS

HI-DISCHARGE AND CONVENTIONAL TYPES

CHAIN BELT COMPANY OF MILWAUKEE



These 36 F-M motor-driven rotary pumps in a large manufacturer's paint mixing room serve distant paint spray booths.

BUY PUMPS HAVING

Efficiency

That's More Than Skin Deep!

THOSE pumps you are about to buy for war production—will they serve you efficiently not only now but also through the years to come?

They will if you choose Fairbanks-Morse Pumps. For these pumps have mechanical superiority which permits them to retain their efficiency long after less highly engineered pumps begin to waste power.

So use your priority to buy pumps for today with an eye for tomorrow. Fairbanks, Morse & Co., 600 S. Michigan Ave., Chicago, Illinois.

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PUMPS
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MOTORS
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Gaskets—see Packing

Gates, Bin—Dust Tight

Chain Belt Co., 1600 W. Bruce St., Milwaukee, Wis.

Gates, Flood & Sluice

American Bridge Co., U. S. Steel Corp. Sub., Carnegie Bldg., Pittsburgh, Pa.
Armco Drainage Products Assn., Middletown, Ohio
Chapman Valve Mfg. Co., Indian Orchard, Mass.
Clow & Sons, James B., 201 N. Talman Ave., Chicago, Ill.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Earle Gear & Machine Co., 4707 Stenton Ave., Philadelphia, Pa. (Operating Mechanism)
Gohi Culvert Mfg. Inc., Newport, Ky.
Iowa Valve Co., Hubbell Bldg., Des Moines, Iowa.
Koppers Co., Bartlett-Hayward Div., 200 Scott St., Baltimore, Md.
Ludlow Valve Mfg. Co., Foot of Adams St., Troy, N. Y.
Manistee Iron Works Co., Manistee, Mich. (Make to special designs)
Mueller Co., Columbian Iron Works, Chattanooga, Tenn., and Decatur, Ill.
National Cast Iron Pipe Co., Tarrant, Birmingham, Ala.
Republic Steel Corp., Republic Bldg., Cleveland, Ohio "Tyton"
Tyton—See Republic Steel Corp.
Toncan Culvert Mfrs. Assn., Republic Bldg., Cleveland, Ohio.

Generators, Electric — see also Plants, Lighting

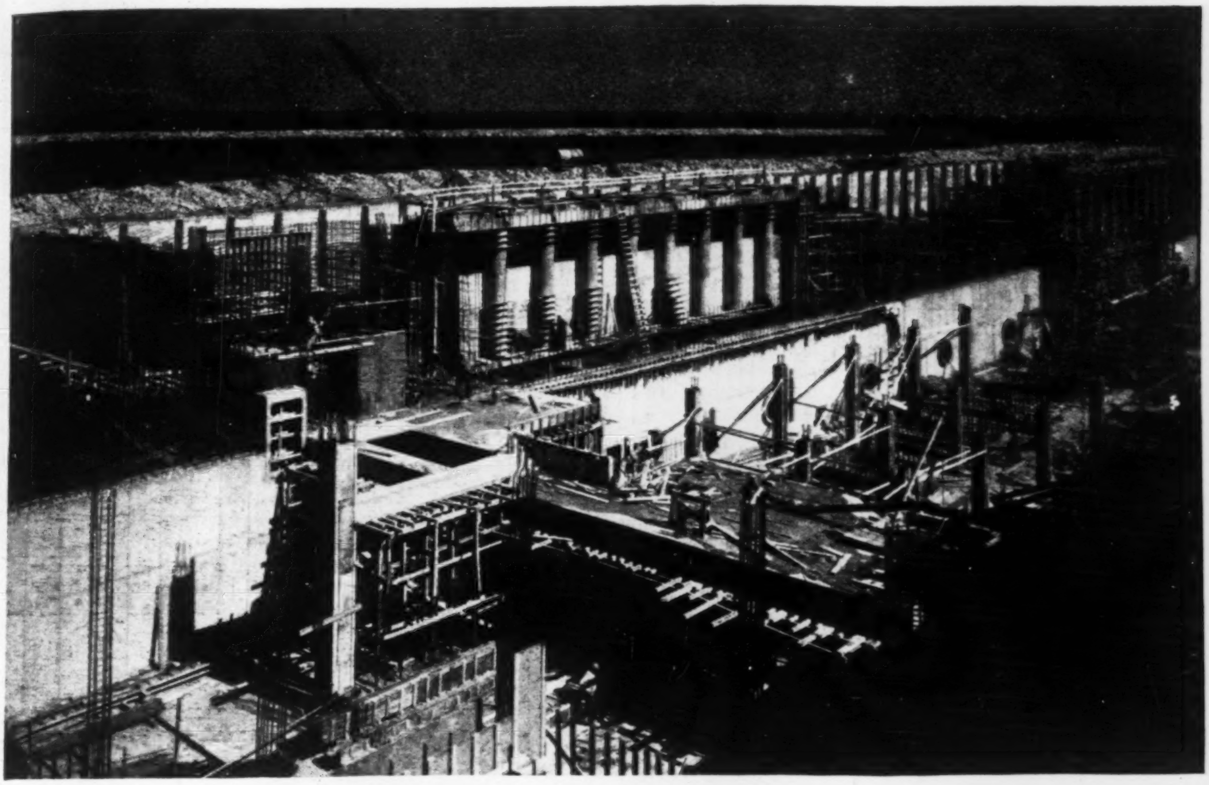
Allis-Chalmers Mfg. Co., W. Allis St., Milwaukee, Wis.
Caterpillar Tractor Co., Peoria, Ill.
Century Electric Co., 1806 Pine St., St. Louis, Mo.
Crocker-Wheeler Elec. Mfg. Co., Ampere, N. J.
Fairbanks, Morse & Co., 600 S. Wabash Ave., Chicago, Ill.
General Electric Co., 1 River Road, Schenectady, N. Y.
Griffin Wellpoint Corp., 725 E. 140th St., New York, N. Y.
Hobart Bros. Co., Troy, Ohio
Kato Engineering Co., 40 Elm St., Mankato, Minn.
Lister-Blackstone, Inc., 1706 S. 68th St., Milwaukee, Wis. "Powr-Pak"
Powr-Pak—See Lister-Blacktone, Inc.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

Gratings, Metal Trim

Stamford Metal Specialty Co., 738 Main St., Stamford, Conn.

Heaters, Unit

American Blower Corp., 6000 Russel St., Detroit, Mich.
Buffalo Forge Co., 481 Broadway, Buffalo, N. Y.
Carrier Corp., 302 S. Geddes St., Syracuse, N. Y.
Clarage Fan Co., 619 Porter St., Kalamazoo, Mich.
General Electric Co., 1 River Rd., Schenectady, N. Y.
Graybar Elec. Co., Lexington Ave. at 43d St., New York, N. Y.
Grinnell Co., Providence, R. I.



SERVICISED PRODUCTS USED IN LARGEST FILTRATION PLANT IN THE WORLD

Chicago's gigantic filtration plant construction is nearing completion. Situated at the lake front, this filtration plant is estimated to provide filtered water service within the city for about 37 percent of the population (approximately 1,250,000) or 54 percent of the entire total area.

SERVICISED furnished an enormous quantity of Sponge Rubber Expansion Joint for use in the concrete floors and walls as well as roof decks. We also designed and manufactured a special premoulded asphalt product that was required for reinforcing bars in the footings. This special product resulted in a great saving of time during the process of pouring concrete.

SERVICISED PRODUCTS are manufactured to comply with all Federal, State and Local Engineers Specifications. Consult us for special requirements on construction jobs—our engineering department will gladly cooperate with you on any problems involving the type of products we manufacture.

Pioneers in the manufacture of various types of Expansion Joints and other products for over twenty-two years.

ENGINEERS and OFFICIALS:

Be sure to send for your FREE 1942 catalog on Expansion Joints and Water Seals

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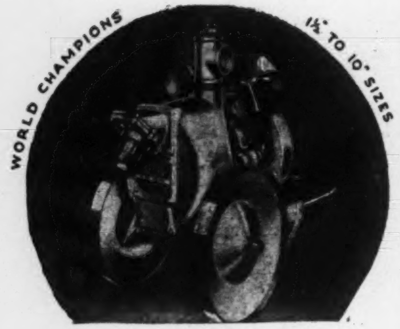
SERVICISED PRODUCTS CORP.

6051 West 65th Street, Chicago, Ill.



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- **JAEGER PRIMING JET** — Up to 5 times faster prime and re-prime — no adjustments, no need to "gun" engine.
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- **PATENTED SELF-CLEANING SHELL.**
- **EVERY PUMP FACTORY TESTED** for high capacity and pressure.
- **COMPLETE RANGE OF SIZES, TYPES** — 3,000 to 220,000 g.p.h.

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Clinton Welded Fabric is the choice of experts for circular and other concrete shapes. UNIFORMITY, both in welding and in tensile strength, raises performance standards, and assures maximum strength at welds. *Every step* in manufacture is completed in our own plant From blast furnace to wire, to electrical welding, it is supervised and tested by our own experts. Clinton Welded Fabric comes in sheets or rolls, cut to your *exact* job specifications . . . saving you the time, trouble, and expense of on-the-job cutting and placing. Wickwire Spencer Steel Company, 500 Fifth Avenue, New York, N. Y.

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It's Electrically Welded
WICKWIRE SPENCER

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McCord Radiator & Mfg. Co., 2587 E. Grand Blvd., Detroit, Mich.

Modine Mfg. Co., Racine, Wis.

B. F. Sturtevant Co., Hyde Park, Boston, Mass.

Trane Co., The, La Cross, Wis.

Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.

Hydrants

Chapman Valve Mfg. Co., Indian Orchard, Mass.

Clow & Sons, Jas. B., 201 N. Talman Ave., Chicago, Ill.

Corey—See Rensselaer Valve Co.

Darling Valve & Mfg. Co., Williamsport, Pa.

Eddy Valve Co., Waterford, N. Y.

Filer & Stowell Co., 147 Becker St., Milwaukee, Wis.

Iowa Valve Co., Hubbell Bldg., Des Moines, Iowa.

Johnson City Fdry. & Mach. Co., Johnson City, Tenn.

Kennedy Valve Mfg. Co., 1900 E. Water St., Elmira, N. Y.

Kupferle Fdry., John C., 2822 N. 1st St., St. Louis, Mo.

Ludlow Valve Mfg. Co., Foot of Adams St., Troy, N. Y.

M & H Valve & Fittings Co., Anniston, Ala.

Mathews—See Wood Co., R. D.

Mueller Co., Decatur, Ill.

National Cast Iron Pipe Co., Tarrant, Birmingham, Ala.

Northrop & Co., 50 Church St., New York, N. Y.

O'Brien—See Smith Mfg. Co., A. P.

Pacific States Cast Iron Pipe Co., Provo, Utah.

Rensselaer Valve Co., Troy, N. Y. "Corey"

Smith Mfg. Co., A. P., 545 N. Arlington Ave., East Orange, N. J. "O'Brien"

Vogel Co., Jos. A., 1203 Lombard St., Wilmington, Del.

Vogt Brothers Mfg. Co., 14th & Main Sts., Louisville, Ky.

Waterous Co., St. Paul, Minn.

Wood Co., R. D., 400 Chestnut St., Philadelphia, Pa. "Mathews"

Indicators

pH, HYDROGEN ION

Beckman—See National Technical Laboratories

Betz, W. H. & L. D., 235 W. Wyoming Ave., Philadelphia, Pa.

Bristol Co., Waterbury, Conn

Cameron—See Wilkins-Anderson Co.

Central Scientific Co., 1700 Irving Pk. Blvd., Chicago, Ill.

Coleman—See Eberbach & Son Co.

Eberbach & Son Co., Fourth & Liberty Sts., Ann Arbor, Mich. "Coleman"

Eimer & Amend, Greenwich & Morton Sts., New York, N. Y.

Fisher Scientific Co., 711 Forbes St., Pittsburgh, Pa.

Foxboro Co., Foxboro, Mass.

Hellige, Inc., 3718 Northern Blvd., Long Island City, N. Y.

LaMotte Chemical Products Co., Towson, Baltimore, Md.

Leeds & Northrup Co., 4986 Stenton Ave., Philadelphia, Pa. "Micromax"

Micromax—See Leeds & Northrup Co.

National Technical Laboratories, 320 Mission St., So. Pasadena, Cal. "Beckman"

Permutit Co., 330 W. 42nd St., New York, N. Y.

Taylor & Co., W. A., 872 Linden Ave., Baltimore, Md.

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Wilkens-Anderson Co., 111 N. Canal St., Chicago, Ill. "Cameron"

Will Corp., 36 Russell St., Rochester, N. Y.

POSITION

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Simplex Valve & Meter Co., 68th & Upland St., Philadelphia, Pa.

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Roller-Smith Co., Bethlehem, Pa.

Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.

Weston Electrical Instrument Corp., 621 Frelinghuysen Ave., Newark, N. J.

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Automatic Temperature Control Co., 34 E. Logan St., Philadelphia, Pa. (Level)

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Bristol Co., Waterbury, Conn.

Brown Instrument Co., 4536 Wayne Ave., Philadelphia, Pa.

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Cochrane Corp., 17th St. & Allegheny Ave., Philadelphia, Pa.

Esterline-Angus Co., Inc., P. O. Box 596, Indianapolis, Ind. (Level)

Foxboro Co., Foxboro, Mass.

Friez & Sons, Julien P., Baltimore St. & Central Ave., Baltimore, Md. (Flow)

Permutit Co., 330 W. 42nd St., New York, N. Y. (Flow)

Pitometer Co., 50 Church St., New York, N. Y. (Flow)

Simplex Valve & Meter Co., 68th & Upland Sts., Philadelphia, Pa. (Flow)

Sparling, R. W., 945 Main St., Los Angeles, Cal. (Flow and Variator)

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Tagliabue Mfg. Co., C. J., Park & Nostrand Aves., Brooklyn, N. Y. "Tag" (Flow)

Taylor Instrument Cos., 100 Ames St., Rochester, N. Y.

Wallace & Tiernan Co., 11 Mill St., Newark, N. J. (Flow)

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Brown Instrument Co., 4538 Wayne Ave., Philadelphia, Pa.

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Tag—See Tagliabue Mfg. Co., C. J.

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Taylor Instrument Cos., 100 Ames St., Rochester, N. Y.

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CROSS-CONNECTIONS *Saved* LONDON!

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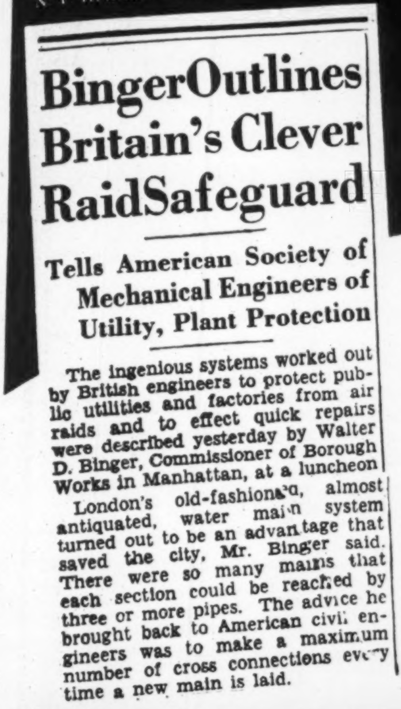


Binger Outlines Britain's Clever Raid Safeguard

Tells American Society of Mechanical Engineers of Utility, Plant Protection

The ingenious systems worked out by British engineers to protect public utilities and factories from air raids and to effect quick repairs were described yesterday by Walter D. Binger, Commissioner of Borough Works in Manhattan, at a luncheon

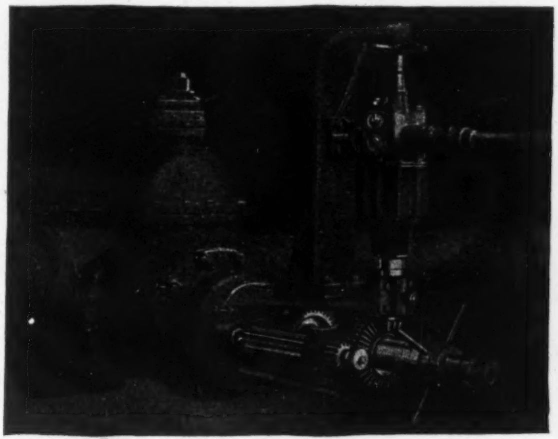
London's old-fashioned, almost antiquated, water main system turned out to be an advantage that saved the city, Mr. Binger said. There were so many mains that each section could be reached by three or more pipes. The advice he brought back to American civil engineers was to make a maximum number of cross connections every time a new main is laid.

A LESSON TO ALL CITIES EXPOSED TO AIR-RAIDS, ACCIDENTS, SABOTAGE

The clipping tells the story! Wherever there are water mains — in cities, towns, big industrial plants — there you need cross-connection PROTECTION for quick repairs, fire and flood control. Do this work with

• SMITH TAPPING MACHINES

For quick low-cost cross connections without shutting off water



Save time, labor, trouble. It takes only a few minutes to attach permanent tapping valve and cut into main. Tapping machine is then removed, new pipe attached to valve, and the job's done! You can RENT various sizes of Smith Tapping Machines, with Smith expert Service. Get in touch with us AT ONCE and be ready for the emergency that's bound to happen sooner or later!

• SMITH EQUIPMENT SERVES THE NATION

Smith Valves, Hydrants and other items of Water Works Equipment are now serving in military centers, airports, war industries plants — besides being STANDARD in leading cities all over the country. Send now for complete catalog . . . and if you can't get what you want now, you CAN plan for post-war improvements.

THE A. P. SMITH MFG. CO.

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59 Oak Vale Ave.,
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524½ First Ave. S.,
Seattle, Wash.

Big Bite or Nibble!

Pierce Gives this Shovel the Power Needed for the Load!

● Slashing into rock and dirt on excavating work means constantly changing loads . . . no one shovelful may use the same amount of power. That's why the fast throttle regulation of the Pierce Flyball Governor is so important . . . here, and wherever power regulation is required.

The instant the shovel begins to dig in the Pierce Governor goes into action . . . delivering power needed by maintaining engine speed constant. This not only means more efficient and economical operation but insures longer life of equipment.

In addition to their highly sensitive control, Pierce Governors bring you the rugged, precision construction so essential to dependable performance under every condition encountered in the field. That's why so many equipment manufacturers use Pierce Flyball Governors as standard equipment.

Any new equipment you can buy will serve you better and longer if it's Pierce-governed. If your present equipment is without a governor, Pierce can supply you on receipt of a preference rating certificate. Or, if your governor needs service, see your nearest Pierce distributor, or send it to the factory, with preference rating certificate.

INSIST ON PIERCE
Flyball Governors on

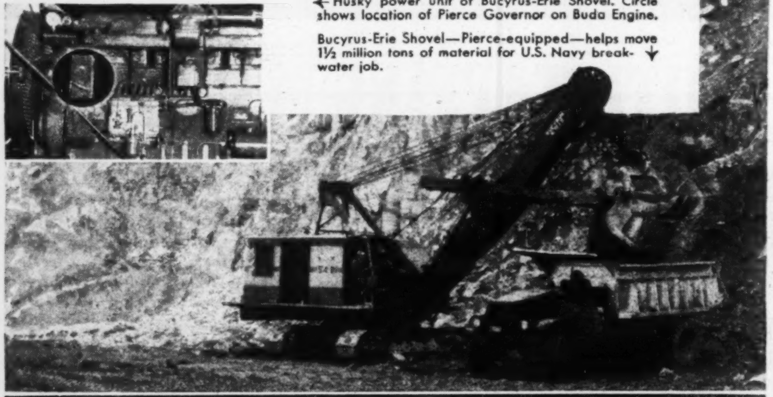
- Power Graders
- Scarifiers
- Rollers
- Crushers
- Sweepers
- Shovels
- Ditchers
- Earth Movers
- Loaders
- Bituminous Spreaders

More Accurate, Last Longer, Give You Peak Performance from Your Equipment

THE PIERCE GOVERNOR COMPANY • 1647 Ohio Ave., Anderson, Ind.

← Husky power unit of Bucyrus-Erie Shovel. Circle shows location of Pierce Governor on Buda Engine.

Bucyrus-Erie Shovel—Pierce-equipped—helps move 1½ million tons of material for U.S. Navy breakwater job.

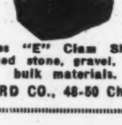


Pierce Governors

THE MOUNT VERNON BRIDGE CO.

Engineers Contractors
STRUCTURAL STEEL
RAILWAY AND HIGHWAY BRIDGES
BUILDINGS AND VIADUCTS
MOUNT VERNON, OHIO

Hayward Buckets



Use this Class "E" Clam Shell Bucket for handling crushed stone, gravel, sand and other bulk materials.

THE HAYWARD CO., 48-50 Church St., N. Y.

Joint, Pipe

PREMOLDED

American Cast Iron Pipe Co., 2930 N 16th St., Birmingham, Ala. "Roll-O Rubber-Ring Joint"
Atlas Mineral Products Co., Mertztown, Pa. "Slipjoint"
Hyd-Ro Ring—See Hyde, Ralph H.
Hyde, Ralph H., Campbell, Cal. "Hyd-R Ring"
Pollard Co., Inc., Jos. G., 142 Ashlan Pl., Brooklyn, N. Y. (Distributor)
Presstite Engrg Co., 3900 Chouteau Ave., St. Louis, Mo.
Roll-On-Rubber-Ring Joint—See American Cast Iron Pipe Co.
Slipjoint—See Atlas Mineral Products Co.
Water & Sewer Equipt. Co., Rome, N. Y.

METAL OR MECHANICAL

Bellmaster—See Dresser Mfg. Co.
Carson-Cadillac Co., 1221 Pinson St., Birmingham, Ala.
Crispin—See Multiplex Mfg. Co.
Dayton—See Dresser Mfg. Co.
Dresser Mfg. Co., Bradford, Pa. also "Bellmaster" "Dayton"
Gustin-Bacon Mfg. Co., 1412 W. 12th St., Kansas City, Mo.
McWane Cast Iron Pipe Co., 1201 Vanderbilt Rd., Birmingham, Ala. (Precaulked)
Moran Flexible Steam Joint Co., 215 W. Main St., Louisville, Ky.
Multiplex Mfg. Co., Berwick, Pa. "Crispin" (Slip Joint)
Regor Products Co., 333 Kearny St., San Francisco, Calif.
Pittsburgh Equitable Meter Co., 400 Lexington Ave., Pittsburgh, Pa. "Raybould"
Raybould—See Pittsburgh Equitable Meter Co.
Spang Chalfant Div., National Supply Co. —See Dresser Mfg. Co.
Tube-Turns, Inc., 224 E. Broadway, Louisville, Ky. (Fittings for Welding)
Victaulic Co. of America, 30 Rockefeller Plaza, New York, N. Y.
Yarnall-Waring Co., 120 Mermaid Ave., Philadelphia, Pa.

POURED

Atlas Mineral Products Co. of Pennsylvania, Mertztown, Pa. "Tegul-Mineralead" "Tegul-Ampco"
Barber Asphalt Corp., Barber, N. J. "Genasco"
Damit—See Quigley Co.
Dickey Clay Mfg. Co., W. S., 400 N. Y. Life Bldg., Kansas City, Mo.
Flexlock—See U. S. Stoneware Co.
Genasco—See Barber Asphalt Corp.
Hayman & Co., Inc., Michael, 956 East Ferry St., Buffalo, N. Y. "Haymanite"
Haymanite—See Hayman & Co., Michael, Inc.
Hotmastic—See Inertol Co. Inc.
Hydraulic Development Corp., 50 Church St., New York, N. Y. "Hydro-Tite" (mineral) "Sani-Tite" (bituminous)
Hydro-Tite—See Hydraulic Development Corp.
Inertol Co., Inc., 470 Frelinghuysen Ave., Newark, N. J. "Hotmastic"
Jointite—See Pacific Flush-Tank Co.
Keystone Asphalt Products Co., 43 E. Ohio St., Chicago, Ill.
Lamar Pipe & Tile Co., Chicago Drive, Grand Rapids, Mich.
Lead Industries Assn., 420 Lexington Ave., New York, N. Y.
Leadite Co., Girard Trust Co. Bldg., Philadelphia, Pa.
Plastex—See Steel Protection & Chemical Co.
Pure Asphalt Products Co., New Market, N. J. "Puroseal"
Puroseal—See Pure Asphalt Products Co.

LEADITE

The Pioneer Self-Caulking Jointing Material for Bell and Spigot Water Pipe

Products

LEADITE and the following tools and equipment for use with LEADITE: BRAIDED JUTE, JOINT RUNNERS, GASOLINE and WOOD BURNING MELTING FURNACES, POURING LADLES, POURING POTS, YARNING IRONS and METAL POURING GATES.

Description

Leadite is principally used for making joints in cast iron bell and spigot water mains; is shipped in powder form in sacks containing 100 pounds.

Users

Water works superintendents, engineers, contractors, mines, railroads and industrial plants all over the world use Leadite. Thousands of miles of pipe jointed with Leadite are in service.

Method of Use

The joint space is first "yarned" and the Leadite is melted and poured into the joint, but requires no caulking. Leadite melts at approximately 250° F. Lead melts at approximately 620° F.

Comparative Quantities

One hundred pounds of Leadite are equivalent to approximately four hundred pounds of pig lead based on the joints being made the same depth with either material. It will be easy to figure the approximate quantity of Leadite required for any given quantity of pipe by referring to our Reference Table, copy of which we shall gladly send to you upon request.

Comparative Cost

Under normal conditions, the economies effected by the use of Leadite save approximately 50% to 75% over the method which requires caulking, owing to the saving effected in material and labor.

Saving

Because Leadite saves on the items of caulking charges, digging of large bell-holes and reduces cost of trench pumping to a minimum, Leadite eliminates most every superfluous operation in jointing cast iron water mains, thus permitting the work to be completed with the least amount of effort.

Tools

As no caulking is required, fewer tools are needed.

No Caulking

Leadite joints require no caulking because Leadite adheres to the pipe from the yarn or jute out to face of bell, making a watertight bond. However, a Leadite joint may be melted or cut out at any time if desired in making connections, etc.

Durability

Leadite has been tested and used for more than 40 years and experience has proven that Leadite joints improve with age.

Expansion and Vibration

Leadite is used with excellent results under railroad tracks, highways and over and under bridges where severe vibration has demonstrated the value of using Leadite on this class of work.

Utility

Leadite is very easy to handle. It is used on all sizes of pipe from four to eighty-four inches in diameter and under all conditions and pressures encountered in water works construction.

Electrolysis

Leadite resists electrolysis.

Damage Suits

Claims for damages caused by joints blowing out are reduced because Leadite joints, if properly made, will not blow out under any pressure common in water works construction.

Transportation

Considerable freight charges are saved because Leadite is light in weight. This also means a saving in cartage and handling on the work because you move approximately one-fourth the weight of jointing material.

Delivery

We make prompt shipments of Leadite in any quantities from stock.

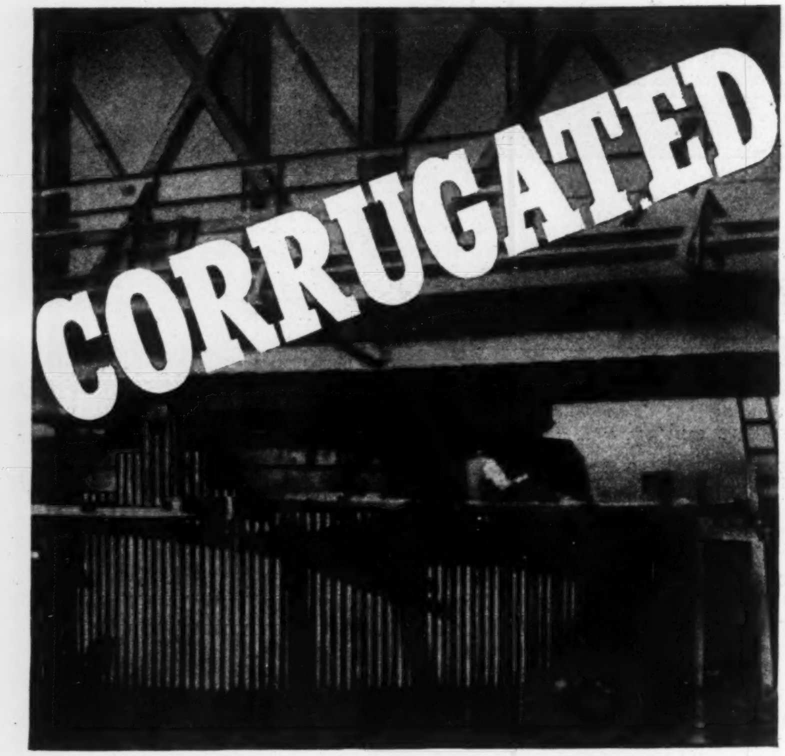
Fuel

Saves fuel because you melt approximately one pound of material instead of four, and less heat is required to melt Leadite than is needed to melt lead.

Be sure it is Leadite and not something "Just as Good"

THE LEADITE COMPANY
Girard Trust Company Bldg., Philadelphia, Pa.

No Caulking



. . . GETS FIRST CALL

Today, when conservation of steel, man hours, time, and power is so important, the advantages of Corrugated Steel Sheet Piling becomes increasingly more evident.

The ease with which it can be transported, handled and used . . . the minimum man hours required to install it . . . the fact that it can be reused again and again and that light economical equipment is all that is needed are all reasons why Corrugated is being used on more jobs every day.

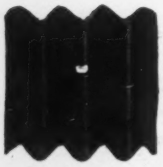
Have you considered its advantages and economy on the jobs you are now figuring? Get the facts! Send for specification book today.

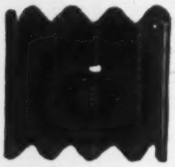
CAINE STEEL COMPANY

1820 North Central Avenue, Chicago, Illinois

CAINE

ROLLED STEEL SHEET PILING


STANDARD


INTERLOCK

Joint Pipe—(Continued)

Q-Seal—See Quigley Co.
Quigley Co., 56 W. 45th St., New York, N. Y. "Q-Seal" "Damit"
Reilly Tar & Chemical Corp., Merchants Bank Bldg., Indianapolis, Ind.
Robinson Clay Products Co., 2nd Nat'l. Bank Bldg., Akron, Ohio
Sani-Tite—See Hydraulic Development Corp.
Steel Protection & Chemical Co., Mooresville, Ind. "Plastex"
Tegul-Ampco—See Atlas Mineral Products Co. of Pennsylvania
Tegul-Mineralead—See Atlas Mineral Products Co. of Pennsylvania
U. S. Stoneware Co., 60 E. 42nd St., New York, N. Y. "Flexlock"
X-Pando Corp., 43-15 36th St., Long Island City, N. Y.

Laboratory Ware & Equipment

Alundum—See Norton Co.
Baldwin Alumina—See Phipps & Bird, Inc.
Betz, W. H. & L. D., 235 W. Wyoming Ave., Philadelphia, Pa.
Carborundum Co., Niagara Falls, N. Y.
Central Scientific Co., 1700 Irving Pk. Blvd., Chicago, Ill.
Chemlab Specialties Co., 52 Alvarado Rd., Berkeley, Calif. (Water Hardness Meters) "Langelier"
Corning Glass Works, Corning, N. Y. "Pyrex"
Crystolon—See Norton Co.
Eberbach & Son Co., Fourth & Liberty Sts., Ann Arbor, Mich.
Eimer & Amend, Greenwich & Morton Sts., New York, N. Y.
Enslow—See Phipps & Bird, Inc.
Everson Mfg. Co., 214 W. Huron St., Chicago, Ill.
Ferguson Co., 1643 Warner St., Baltimore, Md. (Turbidimeter)
Hellige, Inc., 37-18 Northern Blvd., Long Island City, N. Y. (Turbidimeters included)
LaMotte Chemical Products Co., Towson, Baltimore, Md.
Langelier—See Chemlab Specialties Co.
Mueller Co., Decatur, Ill., Chattanooga, Tenn.
Northrop & Co., 50 Church St., New York, N. Y. (Distributors) "Taylor"
Norton Co., 1 New Bond St., Worcester, Mass. "Alundum" "Crystolon"
Omega Mach. Co., 4010 Penn Ave., Kansas City, Mo.
Phipps & Bird, Inc., 915 E. Cary St., Richmond, Va. (Stability Indicators) (also Mixers) "Enslow"
Precision Scientific Co., 1750 N. Springfield Ave., Chicago, Ill.
Pyrex—See Corning Glass Works
Taylor & Co., W. A., 7300 York Rd., Baltimore, Md.
Wallace & Tiernan Co., 11 Mill St., Newark, N. J. (Color Comparators)
Wilkens-Anderson Co., 111 N. Canal St., Chicago, Ill. (Coleman Universal spectro photometer)
Will Corp., 36 Russell St., Rochester, N. Y.
Wilson Chemical Feeders, Inc., 110 Washington St., Buffalo, N. Y.

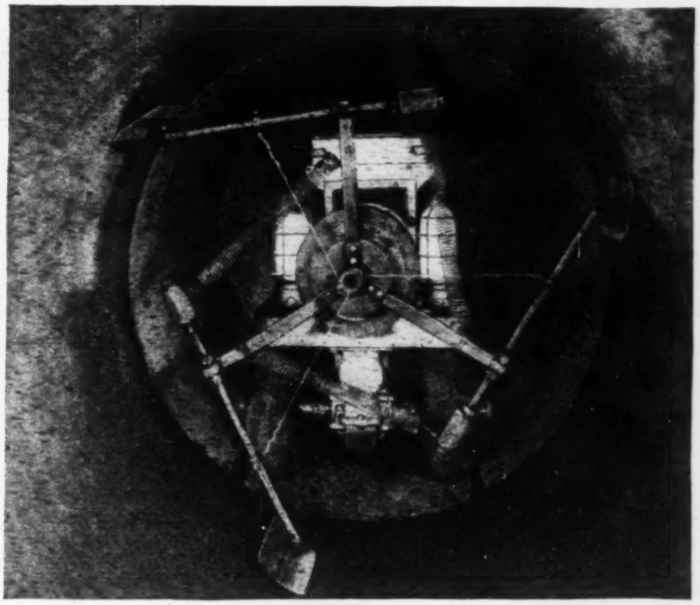
Lining, Pipe & Tank (See also Coatings)

CEMENT

Activated Alum Corp., 5701 Pennington Ave., Baltimore, Md. "Tate Process"
Centriline Corp., 140 Cedar St., New York, N. Y.
Tate Process—See Activated Alum Corp.

IS YOUR WATER SUPPLY LINE A DRAIN

ON THE CITY BUDGET?



The Centriline process is a rapid and economical method of reconditioning pipe lines. It consists of first cleaning the main and then applying, by centrifugal force, a dense cement mortar lining of required thickness, mechanically troweled to a smooth finish.

—*it's time to Centriline!*

Have corrosion and tuberculation invaded your pipe lines? Are they *now* wreaking their costly destruction and decreasing carrying capacity? *Then it's time to recondition!*

A protective inner lining of dense cement, applied speedily and economically the Centriline way, will restore the high efficiency of your pipe lines. Providing an ever-smooth, non-corrosive, non-tuberculating surface, this sleek new lining will permanently maintain a high coefficient and protect the underlying metal—whether steel or cast iron. Erase future depreciation costs and pumping expenditures. Centriline now and safeguard your initial investment.

Wherever your pipe line is situated, whatever its length—if its diameter is 30″ or more—our men can quickly reach and recondition it. We welcome your inquiry. Go all out for Victory—save what you have!

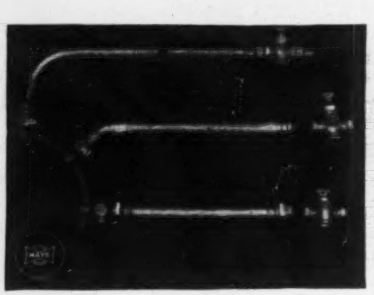
CENTRILINE PROCESS

CENTRILINE CORPORATION

144 CEDAR STREET • NEW YORK, N. Y.

Restores and Protects Pipe-Line Carrying Capacity

HAYS
Can Meet
Your New
Requirements



WHERE copper tubing is no longer available for installations, other metals, such as iron or lead, must be utilized to fill water works requirements.

For many years the Hays line has included water works products for these alternate materials. Therefore fittings for lead pipe with wiped or flanged joints, or cast iron pipe are available for prompt shipment. For lines over 1½" Hays can supply stops with brass plugs and cast iron bodies.

Typical methods of underground installations are illustrated above. Write for catalogs as well as special information applying to present-day adaptations.

HAYS MFG. CO., ERIE, PA.

COPPER • LEAD
BRASS • IRON
HAYS WATER WORKS PRODUCTS
Since 1869

Lining, Pipe & Tank (See also Coatings)—(Continued)

RUBBER

American Hard Rubber Co., 11 Mercer St., New York, N. Y.
du Pont de Nemours & Co., Inc., E. I. Rubber Chemical Div., du Pont Bldg., Wilmington, Del. (synthetic) "Neoprene"
Goodrich Co., B. F., 500 S. Main St., Akron, Ohio
Goodyear Tire & Rubber Co., 1144 E. Market St., Akron, Ohio "Plioweld"
Manhattan Rubber Mfg., Div. of Raybestos-Manhattan, Inc., 61 Willett St., Passaic, N. J.
Neoprene—See du Pont de Nemours & Co. Inc., E. I.
Paramount Rubber Service, Inc., 1430 Rosedale Court, Detroit, Mich.
Plioweld—See Goodyear Tire & Rubber Co.
United States Rubber Co., 1230 Sixth Ave., New York, N. Y.

Locators, Pipe

Aqua Survey & Instrument Co., 1409 Marlowe Ave., Cincinnati, Ohio
Blake, Frank N., North Adams, Mass.
Darley, W. S. & Co., 2810 W. Washington Blvd., Chicago, Ill.
Geophone—See Globe Phone Mfg. Co.
Globe Phone Mfg. Co., Reading, Mass. "Geophones"
M-Scope—See Pollard Co., Jos. G.
Northrop & Co., 50 Church St., New York, N. Y. (Distributors) Globe
Pollard Co., Inc., Jos. G., 142 Ashland Pl., Brooklyn, N. Y. "M-Scope"
Water Leak Detector Co., 166 N. Third St., Columbus, Ohio

Lubrication

Alemite Corp., Division of Stewart Warner, 1828 Diversey Blvd., Chicago, Ill. (Pressure system)
Cities Service Oil Co., 70 Pine St., New York, N. Y.
Dixon Crucible Co., Jos., 167 Wayne St., Jersey City, N. J.
Fiske Bros. Refining Co., 129 Lockwood St., Newark, N. J.
Gray Co., Inc., 60 11th Ave., N.E., Minneapolis, Minn. (Pressure Equipment)
Gulf Oil Corp., Gulf Bldg., Pittsburgh, Pa.
Houghton & Co., E. F., 3rd, American & Somerset Sts., Philadelphia, Pa.
Kendall Refining Co., Bradford, Pa.
Lion Oil Refining Co., Eldorado, Ark.
MacMillan Petroleum Corp., 530 W. 6th St., Los Angeles, Calif.
Ohio Oil Co., Findlay, Ohio
Oil-Rite Corp., 3466 S. 13th St., Milwaukee, Wis. (Constant Level Lubricator)
Pure Oil Co., 12 S. 12th St., Philadelphia, Pa.
Quaker State Oil Refining Co., Oil City, Pa.
Shell Oil Co., Shell Bldg., San Francisco, Calif.
Shell Oil Co., 50 W. 50th St., New York, N. Y.
Sinclair Refining Co., 630 Fifth Ave., New York, N. Y.
Socony-Vacuum Oil Co., 26 Broadway, New York, N. Y.
Standard Oil Co. of Calif., Standard Oil Bldg., San Francisco, Calif.
Standard Oil Co. of Ind., 910 S. Michigan Ave., Rm. 213, Chicago, Ill.
Standard Oil Co. of N. Y., 26 Broadway, New York, N. Y.
Sun Oil Co., 1608 Walnut St., Philadelphia, Pa.
Texas Co., The, 135 E. 42nd St., New York, N. Y.
Tide Water Oil Co., 17 Battery Pl., New York, N. Y.
Valvoline Oil Co., 527 E. 5th St., Cincinnati, Ohio

Machines

PIPE TAPPING

Hays Mfg. Co., 12th & Liberty Sts., Erie, Pa.
Mueller Co., Decatur, Ill.
Smith Mfg. Co., A. P., 545 N. Arlington Ave., East Orange, N. J.

PIPE THREADING, SEE CUTTERS, PIPE

THAWING

Bernz, Otto, Co., 280 Lyell Ave., Rochester, N. Y.
Chausse, W. G., 4453 14th St., Detroit, Mich.
Darley, W. S. & Co., 2810 W. Washington Blvd., Chicago, Ill.
Engesser Electric Mfg. Co., Watertown, N. Y.
General Electric Co., 1 River Rd., Schenectady, N. Y.
Hauck Mfg. Co., 124-136 Tenth St., Brooklyn, N. Y.
Hobart Bros., The, 1220 Hobart Rd., Troy, Ohio.
Macleod Co., The, 2232 Bogen St., Cincinnati, Ohio
Unique Mfg. Co., Inc., 221 W. Walton St., Chicago, Ill.

Machine, Pipe Boring — See Pushers, Pipe

Manholes

Cleveland Trencher Co., 1220 Huron Rd., Cleveland, Ohio (Forms) "Penote"

COVERS & FRAMES

Clow & Sons, James B., 201 N. Talman Ave., Chicago, Ill.
Filer & Stowell Co., 147 E. Beecher St., Milwaukee, Wis.
Lamar Pipe & Tile Co., Chicago Dr., Grand Rapids, Mich.
Leffel & Co., James, 426 East St., Springfield, Ohio.
National Cast Iron Pipe Co., Tarrant, Birmingham, Ala.
Northrop & Co., 50 Church St., New York, N. Y. (Distributors)
Trohn's Supplies, Inc., 201 Hoyt St., Mamaroneck, N. Y. (Tapes for covers)
Vapor Recovery Systems, The, P. O. Box 231, Compton, Calif.
Warren Foundry & Pipe Corp., 11 Broadway, New York, N. Y.
Wilcox, Crittenden & Co., Middletown, Conn.

CUSHIONS

Manhattan Rubber Mfg. Co., Div., Raybestos-Manhattan, Inc., 61 Willett St., Passaic, N. J.
Tapax Mfg. Co., Mamaroneck, N. Y. (Tape)
Turbine Sewer Machine Co., State St., Milwaukee, Wis.

Metals, Corrosion or Wear Resistant

Aluminum Co. of America, Gulf Bldg., Pittsburgh, Pa., (Non-ferrous)
American Brass Co., Waterbury, Conn. (Non-ferrous) "Everdur"
American Manganese Steel Co., 389 E. 14th St., Chicago Heights, Ill.
American Rolling Mill Co., Middletown, Ohio. (Ferrous)
Ampco Metal, Inc., Milwaukee, Wis. (Non-ferrous)
Bethlehem Steel Co., Bethlehem, Pa. (Ferrous)
Bridgeport Brass Co., E. Main St., Bridgeport, Conn.

Metals, Corrosion or Wear Resistant—(Continued)

Carnegie-Illinois Steel Corp., U. S. Steel Corp. Sub., Carnegie Bldg., Pittsburgh, Pa. (Ferrous)
Chase Brass & Copper Co., Waterbury, Conn. (Non-ferrous)
Everdur—See American Brass Co.
Hills-McCanna Co., 2349 Nelson St., Chicago, Ill.
International Nickel Co., 67 Wall St., New York, N. Y. (Non-ferrous) "Monel"
Lukens Steel Co., Coatesville, Pa. "Nickelclad"
Monel—See International Nickel Co.
New Jersey Zinc Co., 160 Front St., New York, N. Y.
Nickelclad—See Lukens Steel Co.
Republic Steel Co., Alloy Steel Div., Republic Bldg., Cleveland, Ohio. (Ferrous)
Revere Copper & Brass, Inc., 230 Park Ave., New York, N. Y. (Non-ferrous)

Meters

CURRENT

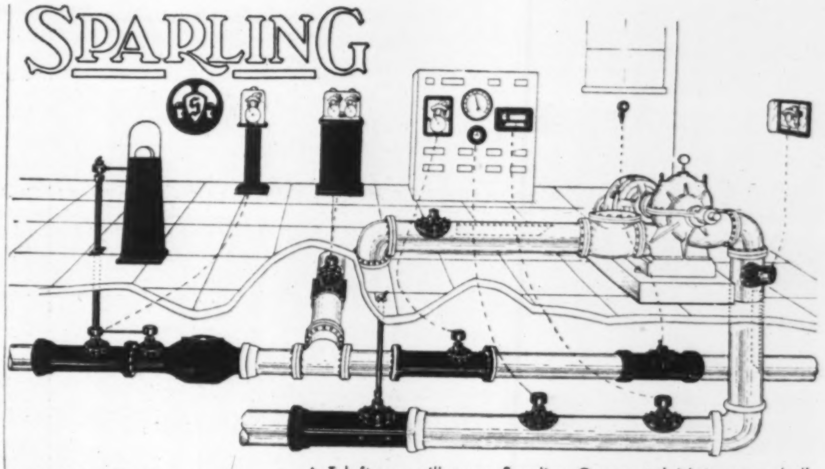
Badger Meter Mfg. Co., 2371 N. 30th St., Milwaukee, Wis.
Hersey Mfg. Co., 381 E. St., S. Boston, Mass.
National Meter Div., Pittsburgh Equitable Meter Co., First Ave. & 42nd St., Brooklyn, N. Y.
Neptune Meter Co., 50 W. 50th St., New York, N. Y.
Phoenix Meter Corp., Princes Bay, Staten Island, N. Y.
Pittsburgh Equitable Meter Co., 400 Lexington Ave., Pittsburgh, Pa.

VENTURI

Bailey Meter Co., 1050 Ivanhoe Rd., Cleveland, Ohio
Builders-Providence, Inc., Div. of Builders Iron Foundry, 9 Codding St., Providence, R. I.
Cochrane Corp., 17th St. & Allegheny Ave., Philadelphia, Pa.
Leupold, Volpel & Co., 425 N. E. 70th Ave., Portland, Ore.
Simplex Valve & Meter Co., 68th & Upland Sts., Philadelphia, Pa.

WATER

American—See Buffalo Meter Co.
Arctic—See Pittsburgh Equitable Meter Co.
Badger Meter Mfg. Co., 2371 N. 30th St., Milwaukee, Wis.
Buffalo Meter Co., 2917 Main St., Buffalo, N. Y. "American" "Niagara"
Empire—See National Meter Co.
Empire-Victory—See Pittsburgh Equitable Meter Co.
Eureka—See Pittsburgh Equitable Meter
Federal—See Smith Mfg. Co., A. P.
Hersey Mfg. Co., 381 E. St., So. Boston, Mass.
IMO—See Pittburgh Equitable Meter Co.
Lambert—See Neptune Meter Co.
National Meter Co., First Ave. & 42nd St., Brooklyn, N. Y. "Empire" "Nash" "Gem" "Crown"
Neptune Meter Co., 50 W. 50th St., New York, N. Y. "Trident"
Niagara—See Buffalo Meter Co.
Northrop & Co., 50 Church St., New York, N. Y. (fire line) (Mfgr.)
Phoenix Meter Corp., 147 Waterbury Ave., Princess Bay, S. I., N. Y.
Pittsburgh Equitable Meter Co., 400 Lexington Ave., Pittsburgh, Pa. "IMO" "Arctic" "Tropic" "Eureka" "Empire-Victory"
Smith Mfg. Co., A. P., 545 N. Arlington Ave., East Orange, N. J. "Federal"
Sparling, R. W., 945 N. Main St., Los Angeles, Calif. (Mainline)
Thompson—See Neptune Meter Co.
Trident—See Neptune Meter Co.
Tropic—See Pittsburgh Equitable Meter Co.



SPARLING

MAIN-LINE METER Setups for SERVICE and SATISFACTION

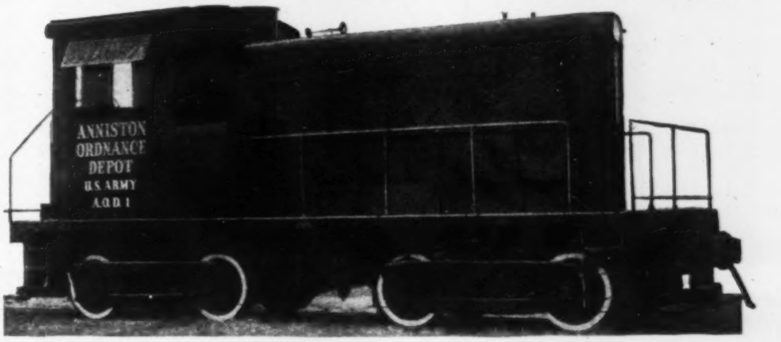
At left you will see a Sparling Compound Meter on a bell and spigot line, with extension control for chlorinator, and a pedestal type Indicator-Totalizer-Recorder. At right is a Saddle-type Meter on the suction line, with wall-mounted totalizer and flow-rate indicator.

Can you pick out the flanged tube meter with panel recorder operated by electric remote control? Or the meter mounted on Transite pipe with instruments recording forward and reverse flows? Check your answers by Page 8 in Sparling Bulletin No. 308.

The big question is—which of these setups would meet your needs for accurate main-line metering?

R. W. SPARLING

LOS ANGELES.Box 3277 Terminal Annex
CHICAGO....3104 S. Michigan Avenue
622 Broadway..........CINCINNATI
101 Park Avenue.........NEW YORK



A SINGLE AIM — *VICTORY*

Davenport Locomotives are contributing to the development of a United Nations WAR STRENGTH that inevitably will crush the forces of aggression. At many key points these dependable power units are moving vital war goods night and day. Davenport's entire facilities are behind this great productive effort. Davenport's prestige is steadily mounting as the locomotives we produce prove their inbuilt merits through superlative performance. To the many users who KNOW, from intimate, first hand experience, the outstanding qualities of modern Davenports, we offer all cooperation within our power toward keeping these valuable power units in good condition.

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LOCOMOTIVES
ELECTRIC OR
MECHANICAL DRIVE

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DAVENPORT LOCOMOTIVE WORKS
A DIVISION OF DAVENPORT BESLER CORPORATION, DAVENPORT, IOWA

OUT OF OUR WAR PRODUCTION WILL COME EVEN BETTER BUTLER PRODUCTS FOR PEACE

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Where aircraft take off and land never was a place for tall buildings. Since the beginning of airfield development, Butler engineers have been building airplane hangars low to the ground to lessen obstruction to flight. Modern warfare uncovered still other reasons for "pancaking" airfield structures. The result is an entirely new hangar design—a radically different type of factory fabricated construction. About its details, we can here say nothing. Coming into its own now—it is a structure in step with the world's fastest developing industry—air transportation.

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FOR SEWAGE TREATMENT AND WATER SUPPLY . . .

● Venturi Tubes, Weirs, Flumes, Nozzles and other primary elements; Mechanically and Electrically operated Registers and Complete Automatic Control Systems.

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Bailey Meter Co. Ltd., Montreal, Canada

WILLIAMS *Buckets*

Welded Rolled Steel Construction

All types and capacities for all conditions. Send for Catalog.

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7000 Central Ave.
Cleveland, Ohio

built by WELLMAN

Meters—(Continued)

Union King—See Phoenix Meter Corp. (Parts only)
Watchdog—See Worthington-Gamon Meter Co.
Worthington-Gamon Meter Co., Harrison, N. J. "Watchdog"

Meter Testing Equipment

Badger Meter Mfg. Co., 2371 N. 30th St., Milwaukee, Wis.
Clark Co., H. W., Mattoon, Ill.
Ford Meter Box Co., Wabash, Ind. (also Portable)
Neptune Meter Co., 50 W. 50th St., New York, N. Y.
Northrop & Co., 50 Church St., New York, N. Y. (Distributors)
Pittsburgh Equitable Meter Co., 400 Lexington Ave., Pittsburgh, Pa. (Meter Prover)
National Meter Div. of Pittsburgh Equitable Meter Co., First Ave. & 42nd St., Brooklyn, N. Y.

Mixers, Chemical

Carter Co., Ralph B., 53 Park Pl., New York, N. Y.
Chain Belt Co., 1600 W. Bruce St., Milwaukee, Wis. "Rex"
Chicago Pump Co., 2336 Wolfram St., Chicago, Ill.
Dorr Co., 570 Lexington Ave., New York, N. Y.
Hendrick Mfg. Co., 52 Dundaff St., Carbondale, Pa.
Infilco, Inc., 325 W. 25th Pl., Chicago, Ill.
Lakeside Engrg. Corp., 222 W. Adams St., Chicago, Ill.
Link-Belt Co., 2045 W. Hunting Park Ave., Philadelphia, Pa.
Municipal Service Co., 532 Dwight Bldg., Kansas City, Mo.
Rex—See Chain Belt Co.
Roberts Filter Mfg. Co., Darby, Pa.
Vogt Mfg. Co., Inc., 1404 W. Main St., Louisville, Ky.

Motors, Electric

Allis-Chalmers Mfg. Co., Milwaukee, Wis. "Lo-Maintenance"
Century Electric Co., 1806 Pine St., St. Louis, Mo.
Cleveland Electric Motor Co., 5213 Chester Ave., Cleveland, Ohio
Crocker-Wheeler Electric Mfg. Co., Ampere, N. J.
Elliott Co., Jeannette, Pa.
Fairbanks, Morse & Co., 600 S. Michigan Ave., Chicago, Ill.
General Electric Co., 1 River Rd., Schenectady, N. Y.
Graybar Electric Co., Lexington Ave., at 43rd St., New York, N. Y. (Distributors)
Lo-Maintenance—See Allis-Chalmers Mfg. Co.
Reliance Electric & Engrg. Co., 1084 Ivanhoe Rd., Cleveland, Ohio
Wagner Electric Corp., 6400 Plymouth Ave., St. Louis, Mo.
Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.

Operator, Valve

Dean, Payne, Peekskill, N. Y.

Ozonators

Ozone Processes, Inc., 1500 Walnut St., Philadelphia, Pa.
Technicraft Engineering Co., 5610 S. Soto St., Los Angeles, Calif. (Portable)

Packing & Gaskets

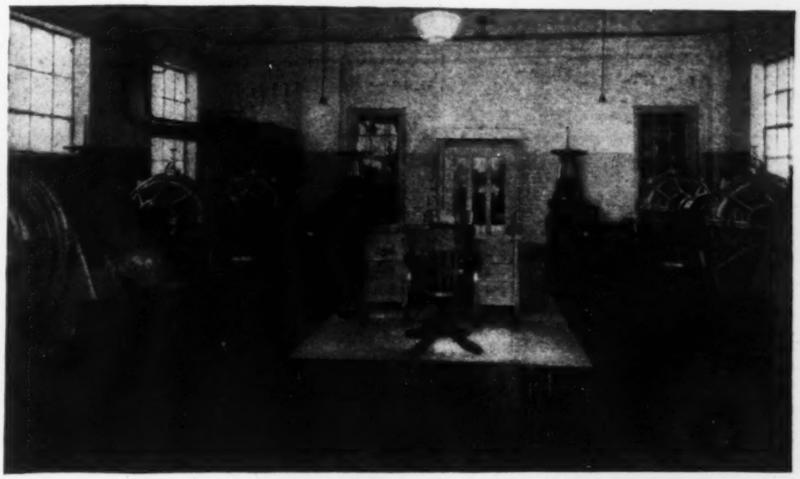
Acme Mfg. & Gasket Co., 3434 Market St., Philadelphia, Pa. (Also Gaskets)

Packing & Gaskets—(Continued)

Alexander Bros., 406 N. Third St., Philadelphia, Pa.
American Metallic Packing Co., 3621 Mexico St., N.S., Pittsburgh, Pa.
Armstrong Cork Co., 926 Concord St., Lancaster, Pa. "Corprene"
Belmont Packing & Rubber Co., Butler & Sepviva Sts., Philadelphia, Pa. (Also Gaskets)
Chicago Belting Co., 113 N. Green St., Chicago, Ill. (Synthetic Rubber)
Cincinnati Rubber Mfg. Co., Franklin Ave., Norwood, Cincinnati, Ohio
Crandall Packing Co., Whittaker St., Palmyra, N. Y.
Darcoid Co., 145 Sixth Ave., New York, N. Y. (Flax) (Also Gaskets)
Durametallic Corp., 2104 Factory St., Kalamazoo, Mich.
Eureka Packing Co., 248 46th St., Brooklyn, N. Y. "Heet Sheet"
France Packing Co., 6512 State Rd., Philadelphia, Pa. (Metallic) "Martell"
Garlock Packing Co., Palmyra, N. Y. "Bitan" "Chevron" (Also Gaskets)
Gatke Corp., 236 N. LaSalle St., Chicago, Ill.
Goodall Rubber Co., 5 S. 36th St., Philadelphia, Pa.
Goodrich Co., B. F., 500 S. Main St., Akron, Ohio (Asbestos)
Goodyear Tire & Rubber Co., 1144 E. Market St., Akron, Ohio (Synthetic Rubber)
Greene, Tweed & Co., 101 Park Ave., New York, N. Y. "Cutno" "Klero" "Palco" "Palmetto"
Hollow Center Packing Co., 6523 Euclid Ave., Cleveland, Ohio (Synthetic Rubber)
Houghton & Co., E. F., 3rd, American & Somerset Sts., Philadelphia, Pa.
Jenkins Bros., 80 White St., New York, N. Y.
Johns-Manville Corp., 22 E. 40th St., New York, N. Y. "J-M" (Also Gaskets)
Keasbey & Mattison Co., Butler Ave., Ambler, Pa. (Also Gaskets)
Klingerit, Inc., 16 Hudson St., New York, N. Y.
Linear Packing & Rubber Co., State Rd. & Levick St., Philadelphia, Pa. "Tacony"
Mabbs Hydraulic Packing Co., 431 S. Dearborn St., Chicago, Ill.
Marsh Co., Chas. W., 36 Hudson St., Muskegon, Mich. (Also Gaskets)
Packing Engrg. Corp., 982 Lincoln Ave., Cranford, N. J. "Ace-O-Pax"
Page Belting Co., Concord, N. H.
Quaker City Rubber Corp., Comly & Milnor Sts., Philadelphia, Pa.
Republic Rubber Div., Lee Rubber & Tire Corp., Albert St., Youngstown, Ohio. (Also Gaskets)
Q-P Mfg. Co., Needham Heights, Mass.
Thermoid Rubber, Div. of Thermoid Co., Whitehead Rd., Trenton, N. J. (Also Gaskets)
United States Asbestos, Div. of Raybestos-Manhattan, Inc., Manheim, Pa. "Duraco"
United States Rubber Co., 1230 Sixth Ave., New York, N. Y.
Victor Mfg. & Gasket Co., 5750 Roosevelt Rd., Chicago, Ill. (Synthetic Rubber) (Also Gaskets)
Water & Sewer Equipment Co., Rome, N. Y. "Bone-dry"
Weston, L. W., Adams, Mass. (Gaskets)

Paint

Acidseal—See Goodrich Co., B. F.
Aluminum Industries, Inc., 2438 Beekman St., Cincinnati, Ohio.
American-Marietta Co., 43 E. Ohio St., Chicago, Ill.



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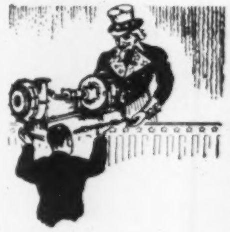

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Dredging • Mining and
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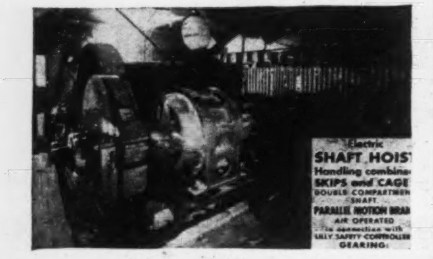

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Manufacturers of the "CEMENT GUN"
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Paint—(Continued)

Arco Co., The, 7301 Bessemer St., Cleveland, Ohio (Camouflage)
Asphalt Products Co., Thompson Rd., Syracuse, N. Y.
Barrett Co., 40 Rector St., New York, N. Y.
Bitumastic—See Wailes Dove-Hermiston Corp.
Devoe & Raynolds Co., Inc., 44th St. & First Ave., New York, N. Y.
Dixon Crucible Co., Joseph, 167 Wayne St., Jersey City, N. J.
du Pont de Nemours & Co., Inc., E. I., du Pont Bldg., Wilmington, Del.
Goodrich Co., B. F., 500 S. Main St., Akron, Ohio (Rubber) "Acidseal" "Koroplate"
Grazoflex—See Inertol Co., Inc.
Hastolite Corp., Technical Coatings Div., 50 Broad St., New York, N. Y.
Hercules Powder Co., Del. Trust Bldg., Wilmington, Del. "Parlon" (Rubber Base)
Hermastic — See Wailes Dove - Hermiston Corp.
Incolete—See Inertol Co., Inc.
Inertol Co., Inc., 470 Frelinghuysen Ave., Newark, N. J. "Ramuc" "Grazoflex" "Incolete" "Torex"
Koroplate—See Goodrich Co., B. F.
National Lead Co., 111 Broadway, New York, N. Y.
New Jersey Zinc Co., 160 Front St., New York, N. Y.
Paint Engineers, Inc., Hawthorne, N. J.
Paramount Rubber Service, Inc., 1430 Rosedale Court, Detroit, Mich.
Paratex—See Truscon Laboratories, Inc.
Parlon—See Hercules Powder Co.
Pittsburgh Plate Glass Co., Grant Bldg., Pittsburgh, Pa.
Premier Oil & Lead Works, 3950 Medford St., Los Angeles, Calif. (Camouflage)
Ramuc—See Inertol Co., Inc.
Reilly Tar & Chemical Corp., Merchants Bank Bldg., Indianapolis, Ind.
Sherwin-Williams Co., Midland Bldg., Cleveland, Ohio.
Steel Protection & Chemical Co., Mooresville, Ind.
Torex—See Inertol Co., Inc.
Truscon Laboratories, Inc., Caniff & G.T. R.R., Detroit, Mich. "Paratex" (Rubber Base)
Wailes Dove-Hermiston Corp., Westfield, N. J., "Bitumastic" "Hermastic"

Pipe

ASBESTOS-CEMENT

Century—See Keasbey & Mattison Co.
Johns-Manville Corp., 22 E. 40th St., New York, N. Y. "Transite"
Keasbey & Mattison Co., Butler Ave., Ambler, Pa. "Century"
Roxite—See United States Stoneware Co.
Transite—See Johns-Manville Corp.
United States Stoneware Co., 60 E. 42nd St., New York, N. Y. "Roxite"

BRASS AND COPPER PIPE AND TUBING

Ambrac—See American Brass Co.
American Brass Co., 25 Broadway, New York, N. Y., also Waterbury, Conn. "Ambrac" "Anaconda" "Everdur"
Anaconda—See American Brass Co.
Bridgeport Brass Co., E. Main St., Bridgeport, Conn.
Chase Brass & Copper Co., Waterbury, Conn.
Everdur—See American Brass Co.
Herculoy—See Revere Copper & Brass Co.
Lewin-Mathe's Co., Miss Ave. & A & S Trks., East St. Louis, Ill.
Mueller Brass Co., Port Huron, Mich.
Revere Copper & Brass Inc., 230 Park Ave., New York, N. Y. "Herculoy"
Scovill Mfg. Co., Waterbury, Conn.
Universal Brass Works, Howard & Lehigh Ave., Philadelphia, Pa.

CAST IRON PIPE AND FITTINGS

Alabama Pipe Co., Anniston, Ala.
American Cast Iron Pipe Co., 2930 N. 16th St., Birmingham, Ala.
Cast Iron Pipe Research Assn., 122 S. Michigan Ave., Chicago, Ill.
Cast Iron Pressure Pipe Inst., Earle Bldg., Washington, D. C.
Central Foundry Co., 386 Fourth Ave., New York, N. Y. "Universal" "Dual-Lok Joint"
Clow & Sons, James B., 201 N. Talman Ave., Chicago, Ill. (Also Emergency Repair Kit)
Colorado Fuel & Iron Corp., Denver, Colo.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Donaldson Iron Co., Emmaus, Lehigh County, Pa.
Dual-Lok joint—See Central Foundry Co.
Glamorgan Pipe & Foundry Co., Lynchburg, Va.
Grinnell Co., 260 W. Exchange, Providence, R. I.
Lynchburg Foundry, Lynchburg, Va.
M. & H. Valve & Fittings Co., Anniston, Ala. (Fittings only)
McWane Cast Iron Pipe Co., 1201 Vanderbilt Rd., Birmingham, Ala.
McWane-Pacific—See Pacific States Cast Iron Pipe Co.
National Cast Iron Pipe Co., Tarrant, Birmingham, Ala.
Pacific States Cast Iron Pipe Co., Provo, Utah "McWane-Pacific"
United States Pipe & Foundry Co., E. Burlington, N. J. (Also mechanical joint pipe)
Universal—See Central Foundry Co.
Walworth Co., 60 E. 42nd St., New York, N. Y.
Warren Foundry & Pipe Corp., 11 Broadway, New York, N. Y. (Also mechanical joint pipe)
Warren Pipe Co. of Mass., 75 Federal St., Boston, Mass.
Wood Co., R. D., 400 Chestnut St., Philadelphia, Pa. (Distributors)

CEMENT LINED PIPE

American Cast Iron Pipe Co., 2930 N. 16th St., Birmingham, Ala.
Central Foundry Co., 386 Fourth Ave., New York, N. Y.
United States Pipe & Foundry Co., Burlington, N. J.
Warren Foundry & Pipe Co., 11 Broadway, New York, N. Y.
Wood Co., R. D., 400 Chestnut St., Philadelphia, Pa.

CONCRETE PIPE

American Concrete Pipe Assn., 33 W. Grand St., Chicago, Ill.
American Pipe & Construction Co., P. O. Box 3428, Los Angeles, Calif.
Concrete Pipe Machinery Co., 9th & Division, Sioux City, Iowa (Machinery)
Lamar Pipe & Tile Co., Grandville Rd., Grand Rapids, Mich.
Lock Joint Pipe Co., 150 Rutledge Ave., Ampere, N. J. (Reinf. concrete pressure)
Universal Concrete Pipe Co., The, 297 S. High St., Columbus, Ohio.

LEAD & LEAD LINED

Lead Industries Ass'n., 420 Lexington Ave., New York, N. Y.
Lead Lined Iron Pipe Co., Wakefield, Mass.

PREFABRICATED

Alco Products, Inc., 30 Church St., New York, N. Y.
Grinnell Co., Providence, R. I.
Ric-Wil Co., Union Commercial Bldg., Cleveland, Ohio.

Pipe—(Continued)

STEEL AND WROUGHT IRON

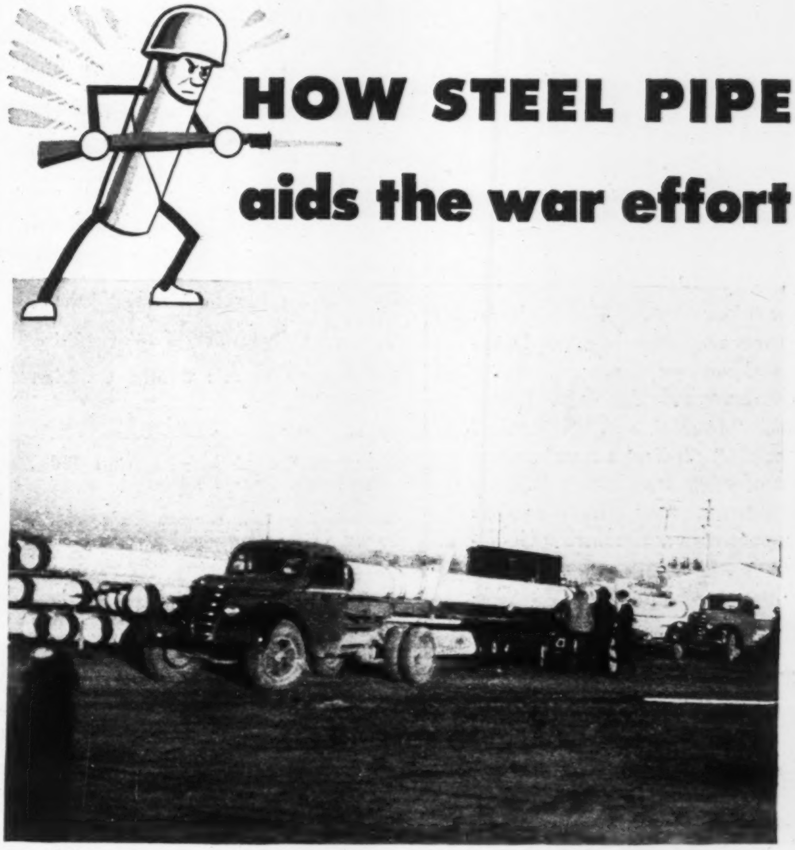
Alco—See American Locomotive Co., Alco Products Division
American Locomotive Co., Alco Products Div., 30 Church St., New York, N. Y. "Alco".
American Rolling Mill Co., Middletown, Ohio ("Armco" spiral welded)
Bethlehem Steel Co., Bethlehem, Pa.
Biggs Boiler Works Co., 1007 Bank St., Akron, Ohio.
Byers Co., A. M., 1600 Clark Bldg., Pittsburgh, Pa. (also W. I.)
Chicago Bridge & Iron Co., 332 S. Michigan Ave., Chicago, Ill.
Cohoes Rolling Mill Co., Cohoes, N. Y. (W. I.)
Graver Tank & Mfg. Co., 4809 Todd Ave., East Chicago, Ind.
Jones & Laughlin Steel Co., 311 Ross St., Pittsburgh, Pa.
Lamar Pipe & Tile Co., Chicago Drive, Grand Rapids, Mich.
Lancaster Iron Works, Lancaster, Pa.
National Tube Co., 1802 Frick Bldg., Pittsburgh, Pa.
Naylor Pipe Co., 1247 E. 92nd St., Chicago, Ill. (also spiral weld)
Petroleum Iron Works, Sharon, Pa.
Republic Steel Corp., Republic Bldg., Cleveland, Ohio. Also "Toncan"
Smith Corp., A. O., 3533 N. 27th St., Milwaukee, Wis.
Spang Chalfant Div., National Supply Co., Grant Bldg., Pittsburgh, Pa.
Taylor Forge & Pipe Works, 4735 W. 14th St., Cicero, Ill. (also spiral weld)
Toncan—See Republic Steel Corp.
Tube-Turns, Inc., 224 E. Broadway, Louisville, Ky.
Wheeling Steel Corp., Wheeling, W. Va.
X-Pando Corp., 43-15 36th St., Long Island City, N. Y.
Youngstown Sheet & Tube Co., Stambaugh Bldg., Youngstown, Ohio.

Pipe, Tubing, Plastic

Blum & Co., Inc., Julius, 532 W. 22nd St., New York, N. Y., "Tenite" tubing (Distributors)
Extruded Plastics, Inc., Norwalk, Conn. "Tenite" tubing (Extruder)
Resisto-flex, Belleville, N. J.
Tenite—See Extruded Plastics, Inc.
Thiokol Corp., Yardville, N. J.

Plants, Lighting

Air-Lite—See Wind-Power Mfg. Co.
Caterpillar Tractor Co., Peoria, Ill.
Delco Appliance Division, General Motors Sales Corp., 391 Lyell Ave., Rochester, N. Y.
Fairbanks, Morse & Co., 600 S. Michigan Ave., Chicago, Ill.
Fitz Water Wheel Co., Penn St. & P. R. R. Hanover, Pa.
Fuller & Johnson Mfg. Co., 1350 E. Washington Ave., Madison, Wis.
General Electric Co., 1 River Road, Schenectady, N. Y.
Harnischfeger Corp., 4400 W. National Ave., Milwaukee, Wis. "P & H"
Homelite Corp., 77 Riverdale Ave., Port Chester, N. Y.
Jacobs Wind Electric Co., 2111 Washington Ave., N. Minneapolis, Minn.
Kato Engineering Co., 40 Elm St., Mankato, Minn.
Kohler Co., Kohler, Wis.
LeRoi Co., 1706 S. 68th St., Milwaukee, Wis.
Lister-Blackstone Inc., 1706 S. 68th St., Milwaukee, Wis. "Nite-Hawk"
Nite-Hawk—See Lister-Blackstone Inc.
Novo Engine Co., Lansing. Mich.
Onan & Sons, D. W., 1643 Royalston Ave., Minneapolis, Minn.



You can conserve metal, time, labor and transportation by using ARMCO Spiral Welded Pipe for water supply and force mains.

ARMCO Pipe has an ultimate strength of 50,000 to 60,000 pounds per square inch. With proper design you get more feet of steel water pipe per ton of metal used. And especially important now, steel pipe is shatterproof. If bombs fall no digging is necessary to uncover hidden fractures outside the bomb crater.

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Remember too that the efficiency of ARMCO Spiral Welded Pipe will carry over into peacetime. If needed, you have your choice of various linings and coatings. Diameters range from 6 to 36 inches; wall thicknesses, from 9/64 to 1/2-inch. Write for the whole story. The American Rolling Mill Co., Pipe Sales Div., 2061 Curtis Street, Middletown, Ohio.

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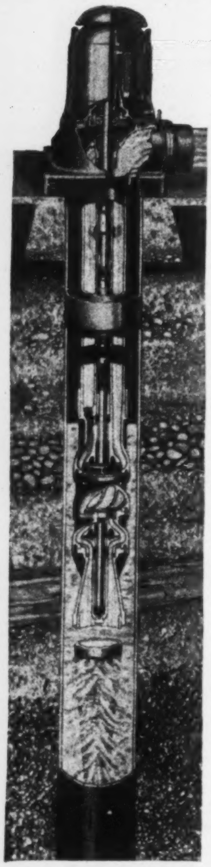
LINE PIPE • PREFABRICATED PIPING • DREDGE PIPE

Are You Specifying A Turbine Pump For the First Time?

Be Sure You Get All The Features That Make Peerless America's Largest Selling Pump

Right now, with war speeded production, you've got to have a pump that takes extra duties in stride. Peerless engineers have vastly improved pump performance with such achievements as "double bowl bearings," "double seal," "hydrofoil principle," "helical action" and a host of other scientific engineering advantages. They permit Peerless Pumps to deliver sustained high efficiencies, to pump longer without shut-downs and to lift water at lowest cost, *in ALL services.*



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TURBINE PUMPS

Plants, Lighting—(Continued)

P & H—See Harnischfeger Corp.
Sea-Pal Radio Co., The, 228 N. La Salle St., Chicago, Ill.
Sterling Machinery Corp., 411 Southwest Blvd., Kansas City, Mo.
Universal Motor Co., 198 Harrison St., Oshkosh, Wis.
Wind Turbine Co., E. Miner St. & P. R. R. West Chester, Pa.
Wind-Power Mfg. Co., Newton, Iowa. "Air-Lite"
Wind-King Electric Mfg. Co., Merrill, Iowa.
Wind-Impeller Electric Works, Ellsworth, Iowa.
Wincharger Corp., 2700 Hawkeye Drive. Sioux City, Iowa.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

Plates, Filter

Aluminum Co. of America, Gulf Bldg., Pittsburgh, Pa. (Holders)
Alundum—See Norton Co.
Carborundum Co., Niagara Falls, N. Y.
Norton Co., 1 New Bond St., Worcester, Mass. "Alundum"

Plugs, Test

Test Plugs Mfg. Co., Niles Center, Ohio

Primers, See also Pumps, Vacuum

Valve & Primer Corp., 111 W. Washington St., Chicago, Ill.

Protection, Cathodic—See Rust Prevention

Protector, Lightning

West Dodd Lightning Conductor Corp., Goshen, Ind. (Rods)
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. (Outdoor meter)

Pumps

STATIONARY

Allis-Chalmers Mfg. Co., West Allis, Milwaukee, Wis.
American Marsh Pumps, Inc., Battle Creek, Mich.
Angleflow—See Fairbanks, Morse & Co.
Bingham Pump Co., E. 7th St., & E. Main, Portland, Ore. (Process)
Buffalo Pumps, Inc., 490 Broadway, Buffalo, N. Y.
Carter, Ralph B., 192 Atlantic Ave., Hackensack, N. J.
Chain Belt Co., 1600 W. Bruce St., Milwaukee, Wis.
Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y.
De Laval Steam Turbine Co., Trenton, N. J.
Deming Co., Salem, Ohio.
Domestic Engine & Pump Co., Shippensburg, Pa.
Downington Mfg. Co., Huber Pump Div., Downington, Pa. (Flexible Rubber Tube, Squeegee Type)
Erie Pump & Engine Works, Medina, N. Y.
Fairbanks, Morse & Co., 600 S. Michigan Ave., Chicago, Ill. "Angleflow"
Gardner-Denver Co., 100 Williamson St., Quincy, Ill.
Ingersoll-Rand Co., 11 Broadway, New York, N. Y.
Jaeger Machine Co., 550 W. Spring St., Columbus, Ohio
Lawrence Machine & Pump Corp., 10 High St., Boston, Mass.
Layne & Bowler, Inc., Memphis, Tenn.
Morris Machine Works, E. Genesee St., Baldwinsville, N. Y.
Myers & Bros., F. E., Ashland, Ohio
Peerless Pump Div., Food Machinery Corp., 301 W. Ave. 26, Los Angeles, Calif.
Pomona Pump Co., Pomona, Calif.
Roy Pumps, Milton, 1360 E. Mermaid Ave., Philadelphia, Pa.
Smith Co., S. Morgan, York, Pa. (Adjustable Impeller)
Sterling Machinery Corp., 411-13 Southwest Blvd., Kansas City, Mo.
Vogt Brothers Mfg. Co., 1402 W. Main St., Louisville, Ky.
Wintroath Pumps, Ltd., 1100 Meridian Ave., Alhambra, Calif.
Worthington Pump & Machy. Co., Harrison, N. J.
Yeomans Bros. Co., 1433 Dayton St., Chicago, Ill.

CENTRIFUGAL

Allen-Sherman-Hoff Co., 225 S. 15th St., Philadelphia, Pa.
Allis-Chalmers Mfg. Co., West Allis, Milwaukee, Wis.
American Well Works, Aurora, Ill.
Aurora Pump Co., Aurora, Ill.
Barrett, Haentjens & Co., Hazleton, Pa.
Byron Jackson Co., 2150 E. Slauson Ave., Los Angeles, Calif.
Chicago Pump Co., 2336 Wolfram St., Chicago, Ill.
Dayton-Dowd Co., Quincy, Ill.
De Laval Steam Turbine Co., Trenton, N. J.
Domestic Engine & Pump Co., Shippensburg, Pa.
Economy Pumps, Inc., Hamilton, Ohio.
Fairbanks, Morse & Co., 600 S. Michigan Ave., Chicago, Ill.
Gardner-Denver Co., Quincy, Ill.
Georgia Iron Works, 605 12th St., Augusta, Ga.
Goulds Pumps, Inc., Seneca Falls, N. Y.
Hills-McCanna Co., 2349 Nelson St., Chicago, Ill.
Hytor—See Nash Engrg. Co.
Ingersoll-Rand Co., 11 Broadway, New York, N. Y.
Jaeger Machine Co., 550 W. Spring St., Columbus, Ohio
LaBour Co., 609 Sterling Ave., Elkhart, Ind.
Lawrence Machine & Pump Corp., 371 Market St., Lawrence, Mass.
Marlow Pumps, Ridgewood, N. J.
Morris Machine Works, E. Genessee St., Baldwinsville, N. Y.
Nash Engrg. Co., 218 Wilson Rd., So. Norwalk, Conn. "Hytor"
Oliver United Filters, Inc., 33 W. 42nd St., New York, N. Y.
Pennsylvania Pump & Compressor Co., Easton, Pa.
Warren Steam Pump Co., Warren, Mass.
Worthington Pump & Machinery Corp., Harrison, N. J.
Yeomans Bros. Co., 1433 Dayton St., Chicago, Ill.

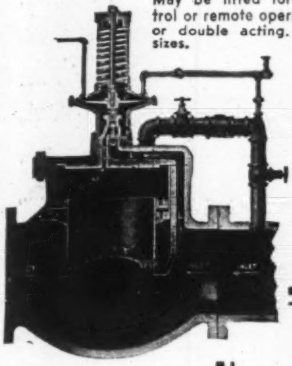
DEEP WELL

Byron Jackson Co., 2150 E. Slauson Ave., Los Angeles, Calif. (Submersible)
Cook, Inc., A. D., Lawrenceburg, Ind. (Turbine)
Deming Co., Salem, Ohio.
Layne & Bowler, Inc., Memphis, Tenn.
Pomona Pump Co., Pomona, Calif.
Sterling Pump Corp., Hamilton, Ohio—Consolidated with Peerless Pump Div., Food Machinery Corp., Canton, Ohio.
Submersible—See Byron Jackson Co.

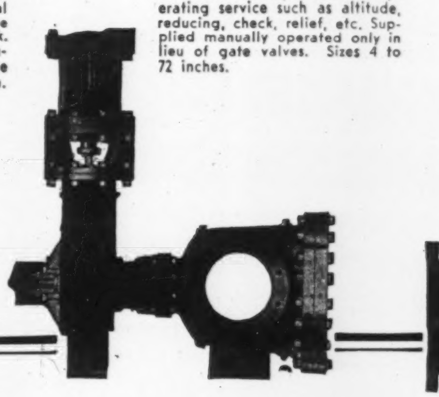
PORTABLE

Barnes Mfg. Co., Mansfield, Ohio
C H & E Mfg. Co., 3849 N. Palmer St., Milwaukee, Wis.
Carter Co., Ralph, B., 192 Atlantic Ave., Hackensack, N. J.
Chain Belt Co., 1600 W. Bruce St., Milwaukee, Wis.

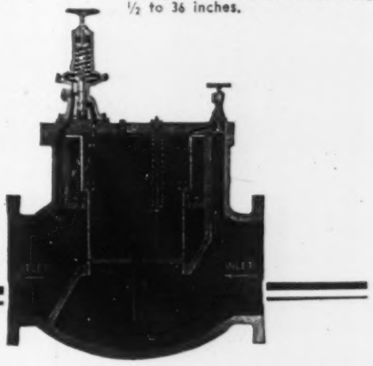
ALTITUDE CONTROL VALVE
Maintains water levels within 3 to 12 in. variation. Differential control permits delayed valve opening for any depth tank. May be fitted for electric control or remote operations. Single or double acting. 2 to 36 in. sizes.



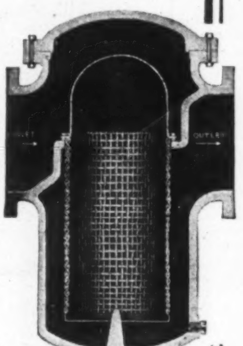
CONE THRU-FLOW VALVE
Furnished for any automatic operating service such as altitude, reducing, check, relief, etc. Supplied manually operated only in lieu of gate valves. Sizes 4 to 72 inches.



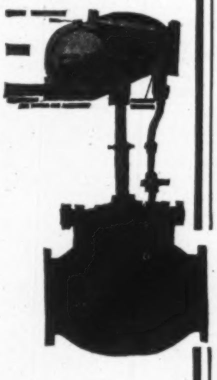
WATER REDUCING VALVE
Gives constant terminal-delivery pressure under varying demands. No shock or jar upon adjustment. No metal contacts. Sizes ½ to 36 inches.



WATER STRAINER
Comes with large capacity basket of suitable mesh to meet all service demands. Readily cleaned. Sizes 3 to 36 inches.



CONTROLLED FLOAT VALVE
Maintains water level within 1" variation. Suitable for closed or open tanks, etc. Furnished without self contained float ball chamber, if desired. Air and water cushioned.



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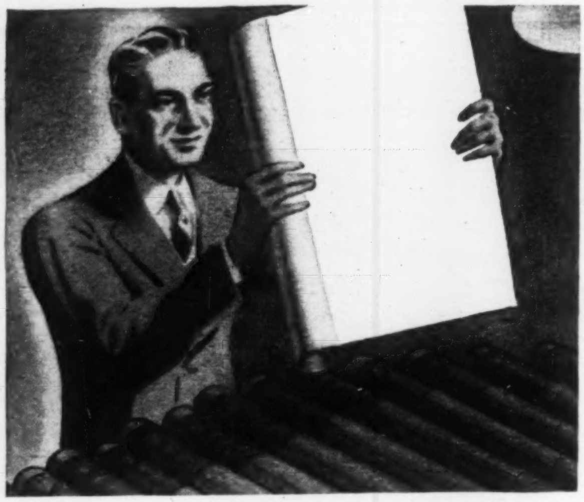

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Homelite Corp., Riverdale Ave., Port Chester, N. Y.
Jaeger Machine Co., 550 W. Spring St., Columbus, Ohio.
LaBour Co., 609 Sterling Ave., Elkhart, Ind.
Marlow Pumps, Ridgewood, N. J.
Moretrench Corp., Rockaway, N. J.
Myers & Bros., F. E., Ashland, Ohio
Northrop & Co., 50 Church St., New York, N. Y. (Distributors) Marlow
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Sterling Machinery Corp., 411-13 Southwest Blvd., Kansas City, Mo.
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Economy Pumps, Inc., Hamilton, Ohio.
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Gardner-Denver Co., Quincy, Ill.
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Pennsylvania Pump & Compressor Co., Easton, Pa.
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Worthington Pump & Machinery Corp., Harrison, N. J.
Yeomans Bros. Co., 1433 Dayton St., Chicago, Ill. (Dry)

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Giant Mfg. Co., Council Bluffs, Iowa.
Greenlee Tool Co., Rockford, Ill.
Hydrauger Corp., Rialto Bldg., San Francisco, Calif.
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Paris Mfg. Co., Paris, Ill. "Parmanca" (Horizontal Drill)
Parmanca—See Paris Mfg. Co.
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Heintz & Kaufman Ltd., Robert Dollar Bldg., South San Francisco, Calif.
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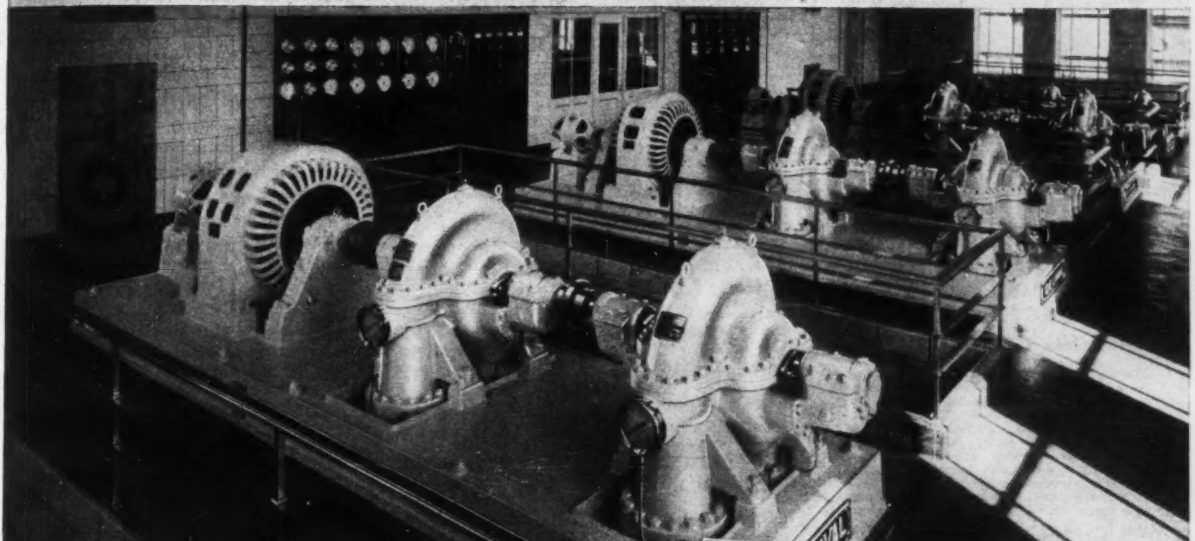

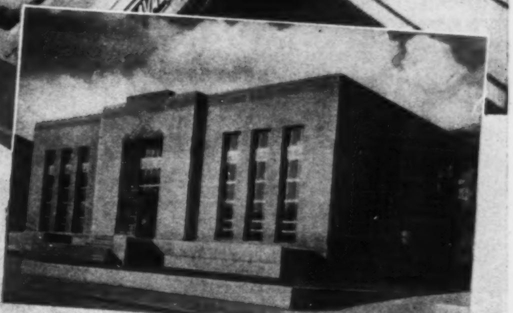

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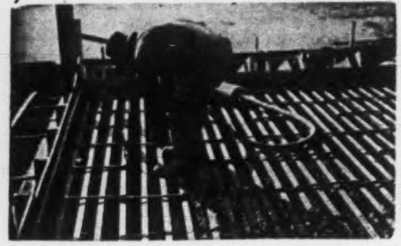

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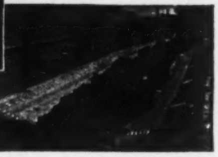

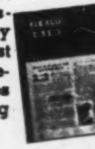

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Technical Radio, 1284 Market St., San Francisco, Calif.
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Western Electric Co., 195 Broadway, N. Y.

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Greenfield Tap & Die Corp., Greenfield, Mass.
Mueller Co., Decatur, Ill.
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Northrop & Co., 50 Church St., New York, N. Y. (Distributors) "Metermaster"

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Philadelphia Gear Works, Limitorque Div., Erie Ave. & G St., Philadelphia, Pa.
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Davidson Enamel Co., Porcelok Div., Clyde, Ohio.
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Republic Stamping & Enameling Co., The, Bedford Ave., Canton, Ohio.
Robertson Co., H. H., Farmers Bank Bldg., Pittsburgh, Pa.
Standard Oil Co. of Ind., 910 S. Michigan Ave., Chicago, Ill. "Korite"
Texas Co., The, 135 E. 42nd St., New York, N. Y.
Truscon Steel Co., Youngstown, Ohio.

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Kron Scale Co., 1720 Fairfield Ave., Bridgeport, Conn.
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Inversand—See Hungerford Terry.
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Ozark Chemical Co., Cosden Bldg., Tulsa, Okla. (Recarbonators)
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Refinite Corp., The, Omaha, Nebr.
Roberts Filter Mfg. Co., Darby, Pa. (Zeolite)
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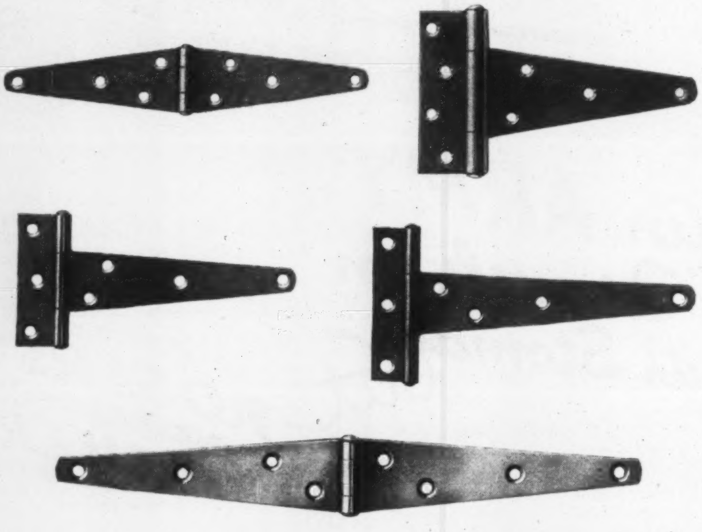

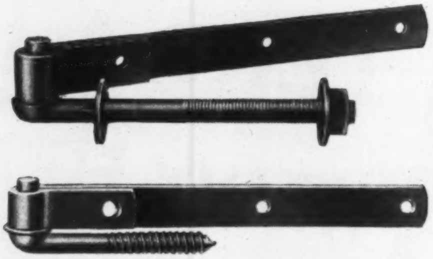

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Simplex Valve & Meter Co., 68th & Upland Ave., Philadelphia, Pa.
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Teletax—See Foxboro Co.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

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Executone, Inc., 415 Lexington Ave., New York, N. Y. (Portable Telephone)
Kellogg Switchboard & Supply Co., 6650 S. Cicero St., Chicago, Ill. "Walkie Talkie"
Telfair Voice-Powered Telfone Corp., 62 Standish Ave., West Orange, N. J.
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Newport News Shipbuilding & Drydock Co., Newport News, Va.
Pelton Water Wheel Co., 2929 19th St., San Francisco, Calif.
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Elliott Co., Jeannette, Pa. (Mechanical Drive)
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Terry Steam Turbine Co., 874 Windsor St., Hartford, Conn.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
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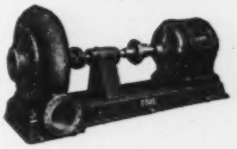

For over 50 years users everywhere have found them a most profitable investment. Built for hardest service in handling sand and gravel. *See Bulletin* 45.

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AIR

APCO—See Valve & Primer Corp.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Crispin—See Multiplex Mfg. Co.
Darling Valve & Mfg. Co., Williamsport, Pa.
Eddy Valve Co., Waterford, N. Y.
Hills-McCanna Co., 2349 Nelson St., Chicago, Ill.
Kennedy Valve Mfg. Co., 1900 E. Water St., Elmira, N. Y.
Ludlow Valve Mfg. Co., Inc., Troy, N. Y.
Multiplex Mfg. Co., Berwick, Pa. "Crispin"
Rensselaer Valve Co., Troy, N. Y.
Valve & Primer Corp., 111 W. Washington St., Chicago, Ill. "APCO"

ALTITUDE

Clayton Mfg. Co., 501 S. Marengo St., Alhambra, Calif.
Foster Engineering Co., 109 Monroe St., Newark, N. J.

GATE, GLOBE & CHECK

Belfield Co., H., Broad & Hamilton Sts., Philadelphia, Pa.
Chapman Valve Mfg. Co., Indian Orchard, Mass.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Darling Valve & Mfg. Co., Williamsport, Pa.
Eddy Valve Co., Waterford, N. Y. (No Globe)
Edward Valve & Mfg. Co., 1200 W. 145th St., East Chicago, Ind.
Fairbanks Co., 393 Lafayette St., New York, N. Y.
Golden-Anderson Valve Specialty Co., Fulton Bldg., Pittsburgh, Pa.
Iowa Valve Co., Hubbell Bldg., Des Moines, Iowa
Jenkins Bros., 80 White St., New York, N. Y.
Kennedy Valve Mfg. Co., 1900 E. Water St., Elmira, N. Y.
Koppers Co., Bartlett Hayward Div., 200 Scott St., Baltimore, Md.
Ludlow Valve Mfg. Co., Inc., Troy, N. Y.
Lunkenheimer Co., Waverly Ave. & Beekman St., Cincinnati, Ohio
M. & H. Valve & Fittings Co., Anniston, Ala.
Ohio Injector Co., Wadsworth, Ohio
Pacific States Cast Iron Pipe Co., Provo, Utah
Reading-Pratt & Cady Div., American Chain & Cable Co., Reading, Pa.
Smith Mfg. Co., A. P., 545 N. Arlington Ave., East Orange, N. J. (No Globe)
Stockhom Pipe Fitting Co., 4000 Tenth Ave., No., Birmingham, Ala.
Vogt Brothers Mfg. Co., 14th & Main Sts., Louisville, Ky.
Walworth Co., 60 E. 42nd St., New York, N. Y.

CONE

Chapman Valve Mfg. Co., Indian Orchard, Mass.
Rensselaer Valve Co., Troy, N. Y.
Smith Co., S. Morgan, York, Pa.

FLOAT

Clayton Mfg. Co., 501 S. Marengo St., Alhambra, Cal.
Ludlow Valve Mfg. Co., Inc., Troy, N. Y.
Ross Valve Mfg. Co., 6 Oakland Ave., Troy, N. Y.

FOOT

Cochrane Corp., 17th St. & Allegheny Ave., Philadelphia, Pa.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Eddy Valve Co., Waterford, N. Y.
Edison Corp., 49 D St., South Boston. Mass.
Iowa Valve Co., Hubbell Bldg., Des Moines, Iowa
Ludlow Valve Mfg. Co., Inc., Troy, N. Y.
Mueller Co., Decatur, Ill., and Chattanooga, Tenn.
Wood, R. D., 400 Chestnut St., Philadelphia, Pa.

HYDRAULIC

Baldwin-Southwark Div., Baldwin Locomotive Works, Eddystone, Pa.
Chapman Valve Mfg. Co., Indian Orchard, Mass.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Darling Valve & Mfg. Co., Williamsport, Pa.
Eddy Valve Co., Waterford, N. Y.
Golden-Anderson Valve Specialty Co., Fulton Bldg., Pittsburgh, Pa.
Homestead Valve Mfg. Co., Coraopolis, Pa.
Iowa Valve Co., Hubbell Bldg., Des Moines, Iowa.
Jenkins Bros., 80 White St., New York, N. Y.
Lunkenheimer Co., Waverly Ave. & Beekman St., Cincinnati, Ohio.
Reading-Pratt & Cady Div., American Chain & Cable Co., Reading, Pa.
Schutte & Koerting Co., 1254 N. 12th St., Philadelphia, Pa.
Smith Co., S. Morgan, York, Pa.
Vogt Brothers Mfg. Co., 14th & Main Sts., Louisville, Ky.
Yarnall-Waring Co., 120 Mermaid Ave., Philadelphia, Pa.

MOTOR OPERATED

Automatic Temperature Control Co., 34 E. Logan St., Philadelphia, Pa.
Barber-Colman Co., Rockford, Ill. "Barcol"
Barcol—See Barber-Colman Co.
Chapman Valve Mfg. Co., Indian Orchard, Mass.
Copes—See Northern Equipment Co.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Cutler-Hammer, Inc., 238 N. 12th St., Milwaukee, Wis. "C-H"
Darling Valve & Mfg. Co., Williamsport, Pa.
Eddy Valve Co., Waterford, N. Y.
General Controls Co., 801 Allen Ave., Glendale, Calif.
Howell-Bunger—See Smith Co., S. Morgan.
Hunt Machine Co., Rodney, Orange, Mass.
Iowa Valve Co., Hubbell Bldg., Des Moines, Iowa.
Jenkins Bros., 80 White St., New York, N. Y.
Kennedy Valve Mfg. Co., 1900 E. Water St., Elmira, N. Y.
Ludlow Valve Mfg. Co., Inc., Troy, N. Y.
Northern Equipment Co., 1945 Grove Dr., Erie, Pa. "Copes" (Solonoid)
Reading-Pratt & Cady Div., American Chain & Cable Co., Reading, Pa.
Ross Valve Mfg. Co., Troy, N. Y.
Ruggles-Klingemann Mfg. Co., Foster Court, Salem, Mass.
Smith Co., S. Morgan, York Pa., "Howell Bunger"

PLUG

Eddy Valve Co., Waterford, N. Y.
Iowa Valve Co., Hubbell Bldg., Des Moines, Iowa.
Pittsburgh Equitable Meter Co., Merco Nordstrom Valve Co., 400 Lexington Ave., Pittsburgh, Pa. (Lubricated plug)
Vogt Brothers Mfg. Co., 14th & Main Sts., Louisville, Ky.
Walworth Co., 60 E. 42nd St., New York, N. Y.

PRESSURE REGULATING

Cash Co., A. W., 20th & Eldorado Sts., Decatur, Ill. (Reducing)
Copes—See Northern Equipment Co.
Foster Engineering Co., 109 Monroe St., Newark, N. J.
Golden-Anderson Valve Specialty Co., Fulton Bldg., Pittsburgh, Pa. (Reducing)
Northern Equipment Co., 1945 Grove Drive, Erie, Pa. "Copes" (Regulating)
Powell Valve Co., Wm., 2525 Spring Grove Ave., Cincinnati, Ohio
Ross Valve Mfg. Co., 6 Oakwood Ave., Troy, N. Y. (Reducing)
Vapor Recovery Systems, The, P.O. Box 231, Compton, Calif.

PUMP

Birch Mfg. Co., 1521 Sedgwick St., Chicago, Ill.

Ventilators, Manhole

Coppus Engrg. Corp., 344 Park Ave., Worcester, Mass.
Homelite Corp., Riverdale Ave., Port Chester, N. Y. (Gas Engine driven)

Waterproofing

Acqua Pruf Inc., 786 Broad St., Newark, N. J.
Allied Asphalt & Mineral Corp., 217 Broadway, New York, N. Y.
American Fluresit Co., 635 Rockdale Ave., Cincinnati, Ohio
Anti-Hydro Waterproofing Co., 295 Badger Ave., Newark, N. J.
Barber Asphalt Corp., Barber, N. J. (Also Fabrics)
Barrett Co., 40 Rector St., New York, N. Y.
Carey Co., Philip, The, Lockland, Cincinnati, Ohio
Cochrane Chemical Co. 432 Danforth Ave., Jersey City, N. J.
Eastern Tricosal Co., Inc., 101 Park Ave., New York, N. Y. "Tricosal"
Flexrock Co., 23rd & Manning Sts., Philadelphia
Flintkote Co., The, 30 Rockefeller Plaza, New York, N. Y.
Inertol Co., Inc., 470 Frelinghuysen Ave., Newark, N. J.
Koppers Co., Tar & Chemical Div., Koppers Bldg., Pittsburgh, Pa.
Master Builders Co., 7016 Euclid Ave., Cleveland, Ohio
Medusa Portland Cement Co., Midland Bldg., Cleveland, Ohio
Paint-Point Corp., 275 Passaic St., Newark, N. J.
Semet Solvay Co., 40 Rector St., New York, N. Y.
Sherwood Waterproofing Corp., 53 Park Pl., New York, N. Y.
Sika, Inc., 330 W. 42nd St., New York, N. Y.
Sonneborn Sons., Inc., L. 88 Lexington Ave., New York, N. Y.
Standard Dry Wall Products, Inc., New Eagle, Pa., "Waterplug"
Texas Co., The, 135 E. 42nd St., New York, N. Y.
Tricosal—See Eastern Tricosal Co., Inc.
Truscon Laboratories, Caniff & GTRR, Detroit, Mich.
Waterplug—See Standard Dry Wall Products, Inc.

Welders & Equipment

Air Reduction Sales Co., 60 E. 42nd St., New York, N. Y. (Distributors) "Hornet"
American Brass Co., Waterbury, Conn. (Rods)
General Electric Co., 1 River Rd., Schenectady, N. Y.
Harnischfeger Corp., 3902 National Ave., Milwaukee, Wis. "P & H"
Hobart Bros., The, Troy, Ohio.
Hornet—See Air Reduction Sales Co.
Lincoln Electric Co., Coit Rd. & Kirey Ave., Cleveland, Ohio "Shield Arc"

Welders & Equipment—(Continued)

Linde Air Products Co., The, Unit of Union Carbide & Carbon Corp., 30 E. 42nd St., New York, N. Y. "Oxweld" "Prest-O-Weld"
Metal & Thermit Corp., 120 Broadway, New York, N. Y. (Rods)
Oxweld—See Linde Air Products Co.
P & H—See Harnischfeger Corp.
Page Steel & Wire Co., Monessen, Pa.
Prest-O-Weld—See Linde Air Products.
Roebling's Sons Co., John A., 640 S. Broad St., Trenton, N. J. (Rods)
Shield Arc—See Lincoln Electric Co.
Union Carbide & Carbon Corp.—See Linde Air Products.
Victor Equipment Co., 844 Folsom St., San Francisco, Calif.
Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.
Wilson Welder & Metals Co., Inc.—Distributed by Air Reduction Sales Co.

Wellpoints

Complete Machinery & Equipment Co., 36-33 11th St., Long Island City, N. Y.
Griffin Wellpoint Corp., 725 E. 140th St., New York, N. Y.
Jaeger Machine Co., 550 W. Spring St., Columbus, Ohio
Moretrench Corp., Rockaway, N. J. and 90 West St., New York, N. Y.
Stang Corp., John W., 2 Broadway, New York, N. Y.

Wells, Drillers

American Drilling Co., 308 Marshall St., Ridgewood, N. J.
Layne & Bowler, Inc., Memphis, Tenn., and Affiliated Companies:
    Layne-Arkansas Co., Stuttgart, Ark.
    Layne-Atlantic Co., Norfolk, Va.
    Layne-Central Co., Memphis, Tenn.
    Layne-Northern Co., Mishawaka, Ind.
    Layne-Louisiana Co., Lake Charles, La.
    Layne-New York Co., New York, N. Y. & Pittsburgh, Pa.
    Layne-Northwest Co., Milwaukee, Wis.
    Layne-Ohio Co., Columbus, Ohio
    Layne-Texas Co., Houston & Dallas, Texas
    Layne-Western Co., Kansas City, Mo., Chicago, Ill., Omaha, Neb.
    Layne-Western Co. of Minnesota, Minneapolis, Minn.
    Layne-Bowler New England Co., Boston, Mass.
    International Water Supply, Ltd., London, Ontario, Canada
Pennsylvania Drilling Co., 1201 Chartiers Ave., Pittsburgh, Pa.
Ranney Co., Inc., Heyburn Bldg., Louisville, Ky.
Ranney Water Collector Corp., of New York, 72 Wall Street, New York, N. Y. (Radial Type)
Sprague & Henwood, Inc., 221 W. Olive, Scranton, Pa.
Star Drilling Machine Co., Akron, Ohio (Drills)

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Aluminum Co. of America, Gulf Bldg., Pittsburgh, Pa. (Aluminum, also Steel Reinforced)
Anaconda Wire & Cable Co., 25 Broadway, New York, N. Y.
American Steel & Wire Co., Rockefeller Bldg., Cleveland, Ohio
Armortite—See Hazard Insulated Wire Works.
Bethlehem Steel Co., Bethlehem, Pa.
Bridgeport Brass Co., Bridgeport, Conn.
General Cable Corp., 420 Lexington Ave., New York, N. Y.
General Electric Co., 1 River Rd., Schenectady, N. Y., Bridgeport, Conn.
Graybar Electric Co., Lexington Ave. at 43rd St., New York, N. Y.
Hazard Insulated Wire Works, Div. of Okonite Co., Wilkes-Barre, Pa. "Armortite" "Loxsteel"
Loxsteel—See Hazard Insulated Wire Works.
Roebling's Sons Co., John A., 640 S. Broad St., Trenton, N. J.
Simplex Wire & Cable Co., 79 Sidney St., Cambridge, Mass.

Wrenches

Chicago Penumatic Tool Co., 6 E. 44th St., New York, N. Y. (Electric) (Pneumatic)
Ingersoll-Rand Co., 11 Broadway, New York, N. Y., (Pneumatic)
Lowell Wrench Co., 54 Commercial St., Worcester, Mass.
Snap-on-Tools Corp., Kenosha, Wis. (Sledge-type)

Wrenches, Pipe

Armstrong Bros. Tool Co., 317 N. Francisco St., Chicago, Ill.
Bonny Forge & Tool Works, Allentown, Pa.
Clark Co., H. W., Mattoon, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.
Ridge Tool Co., The, Elyria, Ohio.
Trimont Mfg. Co., 55 Amory St., Boston, Mass.
Walworth Co., 60 E. 42nd St., New York, N Y.
Williams & Co., J. H., 400 Vulcan St., Buffalo, N. Y.

Zeolite. See Softeners. Water

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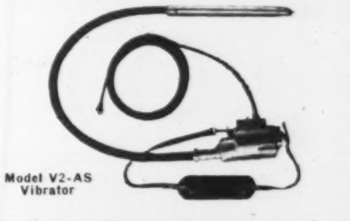

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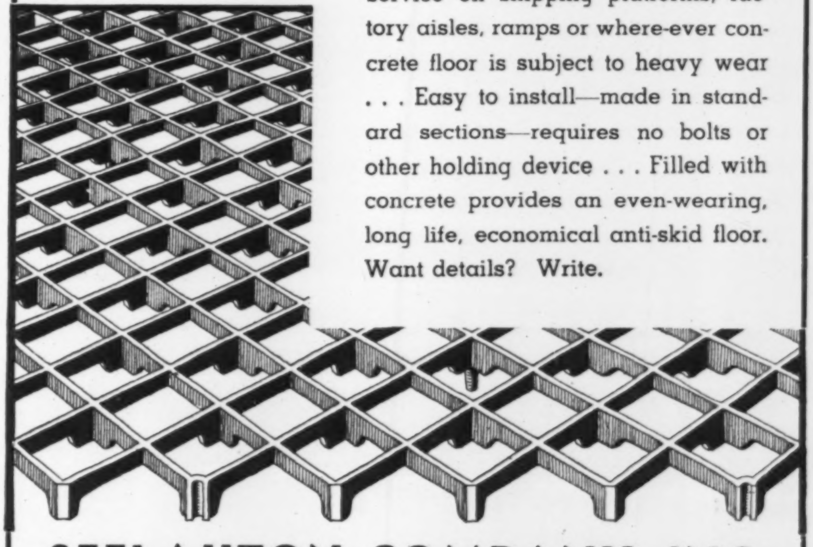

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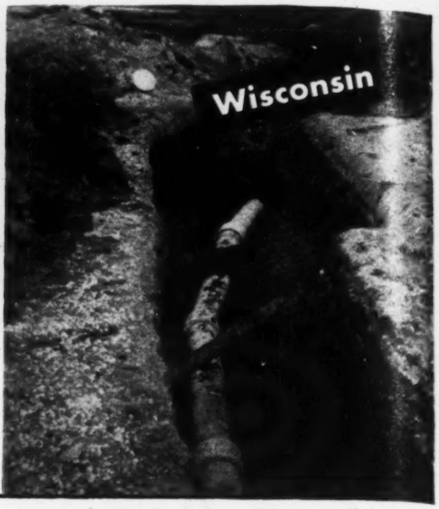
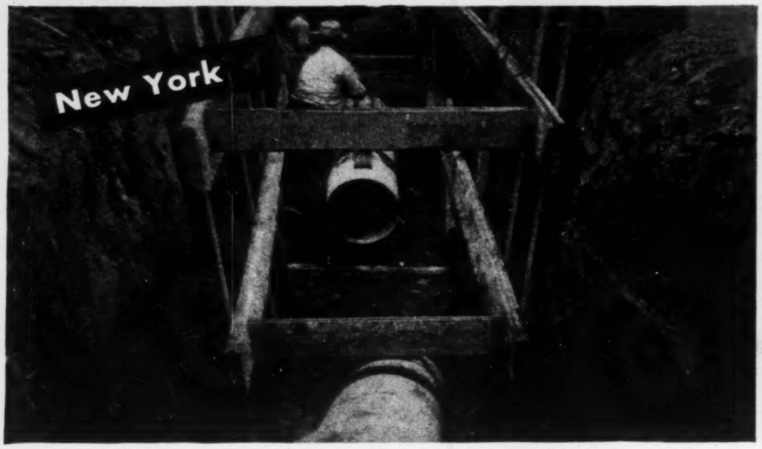


From Coast



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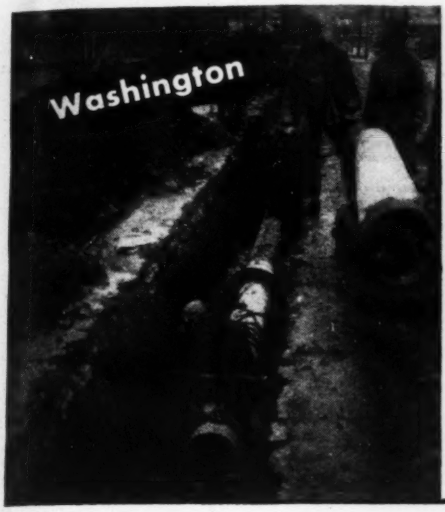
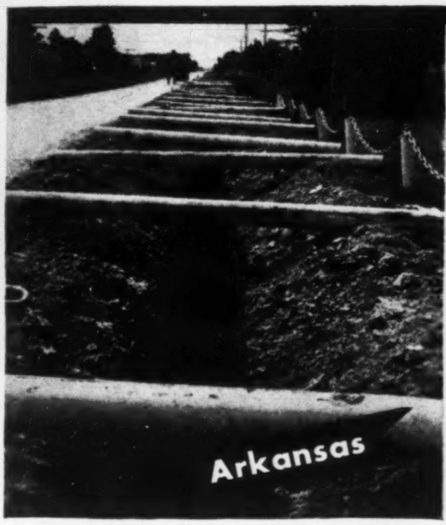


to Coast



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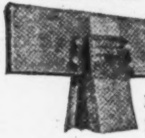

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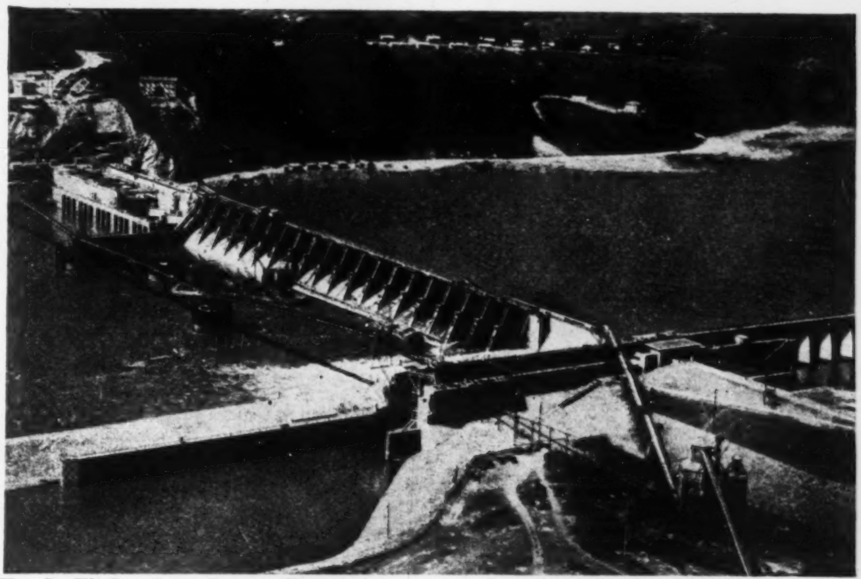

Watts Bar TVA Dam, Eastern Tennessee. This multiple purpose dam will extend navigation channel 72 miles upstream, aid in controlling floods, and generate power vitally needed for the Victory Program.

SEE OUR CATALOG IN SWEET'S

See section 3

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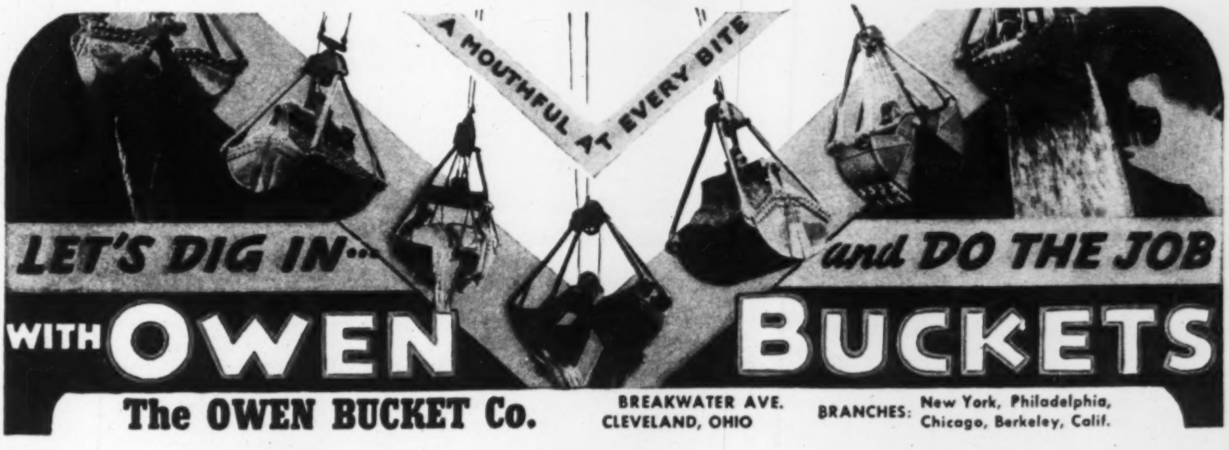

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